Coastal Hazards Resilience Network
2019 Annual Meeting

Coastal Hazards Resilience Network (CHRN) 2019 Annual Meeting
Wednesday June 5th, 2019 – 9:00 a.m. - 4:00 p.m.
University of Washington Tacoma Campus

Theme: Coastal Flooding & Erosion

Audience: Meeting open to CHRN members and stakeholders, agencies, local governments, academics, Tribes, and non-profits affected by and involved in coastal hazards planning.
Goals:

- To promote information exchange on the current state of knowledge about erosion and coastal flooding, and share resources needs for and lessons learned from projects in Washington State and other coastal states.
- To create a space for practitioners and stakeholders to connect and develop relationships, and ultimately partnerships.
- To create an opportunity for more coordination and collaboration between actors when addressing coastal hazards and improving coastal resilience.

Agenda

8:30-9:00 **Check-in, Coffee, and Networking Board**
Purpose: To give everyone the opportunity to mention projects or issues they are working on and to connect and potentially partner with other audience members.

9:00-9:15 **Welcome**
Felicia Olmeta-Schult, Washington Sea Grant Marine Policy Fellow
Shoreline & Coastal Management, Washington Department of Ecology

9:15-10:45 **Coastal Flooding & Erosion State of the Science**
**Four 15-min talks with 20 min for discussion with the presenters.*
**Time for 2 short Q&A after each talk.*

Purpose: To share with the audience the current state of knowledge around erosion and coastal flooding in Washington State. This will be done by presenting both scientific and local community perspectives on these hazards, and what we could expect in the future.

- **Coastal Erosion Assessment for Grays Harbor County Hazard Mitigation**
  George Kaminsky, Coastal Monitoring & Analysis, Department of Ecology
- **Where we are and what's next?**
  Jerry Franklin, Floodplain Management, Department of Ecology
  Ted Perkins, FEMA Region 10
- **Washington Coastal Resilience Project Update: Extreme Coastal Water Level Assessment to support SLR Planning**
  Ian Miller, Washington Sea Grant
- **What's making future sea level so hard to predict accurately?**
  Robert Bindschlader, NASA Emeritus Scientist

10:45-11:00 **Break**

11:00-12:30 **How are Coastal Communities in Washington Dealing with these Issues?**

**Four 15-min talks with 20 min for questions at the end.*
**Time for 2 short Q&A after each talk.*

Purpose: To give an opportunity to coastal communities to explain how they addressed or will address erosion and coastal flooding issues, and to share lessons learned from these projects.

- **Updates from the shoreline: Addressing sea level rise impacts in King County**
  Lara Whitely Binder, King County
- **Sea Level Rise Hazard Mapping, Decision Tools, & Data**
  Andrea MacLennan, Coastal Geologic Services
- **Nature-Based Dynamic Revetment for Shoreline Stabilization at North Cove**
  George Kaminsky, Coastal Monitoring & Analysis, Department of Ecology
- **Low and Wet: A Multiple Benefits, Multiple Entity Coastal Flooding Adaptation Case Study from the Dungeness River Delta**
  Ian Miller, Washington Sea Grant

12:30-1:15 **Lunch (provided)**

1:15-2:30 **How are other States Dealing with these Problems?**

**Three 15-min talks and 20 min for questions at the end.*
**Time for 2 short Q&A after each talk.*

Purpose: To learn about regulations, tools, resources and other approaches used by other coastal states to address erosion and coastal flooding.

- **Addressing coastal hazards through the NC Coastal Zone Management Program**
  Braxton Davis, North Carolina Division of Coastal Management
  Department of Environmental Quality
- **Addressing coastal hazards along the California coast through planning and permitting**
  Mary Matella, California Coastal Commission
- **Addressing coastal erosion in Hawaii**
  Justine W. Nihipali, Hawaii Coastal Zone Management Program

2:30-2:45 **Break**

2:45-3:45 **CHRN Happenings**

**Three 20-min talks (including Q&A).*

Purpose: To present work in progress on the new CHRN website, including tools such as the Coastal Adaptation Atlas. To discuss the future of the CHRN annual meeting and its conversion into an annual conference.

- **The CHRN website: a Revamped Resource**
  Jackson Blalock, Washington Sea Grant

- **CHRN's Adaptation Case Studies**
  Katrina Radach, Washington Sea Grant Marine Policy Fellow
  The Nature Conservancy
- **Coastal Hazards Conference 2020**
  Bobbak Talebi, Shoreline & Coastal Management, Department of Ecology

3:45-4:00 **Closing**
Felicia Olmeta-Schult, Washington Sea Grant Marine Policy Fellow
Shoreline & Coastal Management, Department of Ecology

4:30-6:00 **Be Happy and Connect with your Colleagues @ Harmon Brewing Company** (1938 Pacific Ave, Tacoma 98402).

See next page for additional details (directions, parking, Wi-Fi access, etc.)

Meeting Details

The CHRN 2019 Annual Meeting will take place at University of Washington Tacoma Campus. Set in the historic Union Station District, UW Tacoma owes its charm to century-old, brick buildings that were built to last by businesses that depended on the railroad in the late 1880s and early 1900s. The 46-acre campus footprint is located on a hillside overlooking the Port of Tacoma and Mount Rainier, on the southern edge of downtown Tacoma, next to museums and the beautifully reconstructed Union Station.

Note: *Non-YMCA member attendees of the event are not permitted to use the recreational facilities (locker rooms and restrooms not included), equipment, services, or programs of the University Y Student Center while in the facility.*

Directions: University Y Student Center (UWY) Room 304, 1710 Market St, Tacoma, WA 98402 (Google Map).

Parking options (click here for parking map):

- There is free street parking around the UWY.
- Lot WT40 (Court 17 Garage; enter from Court C and 17th; 18 all-day parking spots available).
- Lot WT31 (SW Jefferson and 21st; bigger lot, also all-day and hourly parking).
- Another option is parking at the Tacoma Dome Garage for free and taking the Link Light Rail that runs every 10 minutes from the garage to campus (about a 5 minute ride).

Lunch and coffee/tea will be provided. Lunch boxes labeled for people with dietary restrictions. Paper cups will be provided. To save from waste, feel free to bring your personal travel mugs.

UW guest wireless access:

1. To login to UW Wi-Fi, please ensure Wi-Fi is turned on via your device settings and select the **University of Washington** as the Wi-Fi network to connect to.
2. Open your internet browser and view a webpage outside the UW to bring up the authentication page.
3. You will then be automatically prompted to enter the supplied **UW NetID**: event0532 and **Password**: w5d4=m9t5=n7a6
4. Once you have successfully logged in (authenticated) you will be able to use services outside the UW for up to 12 hours without having to re-authenticate.

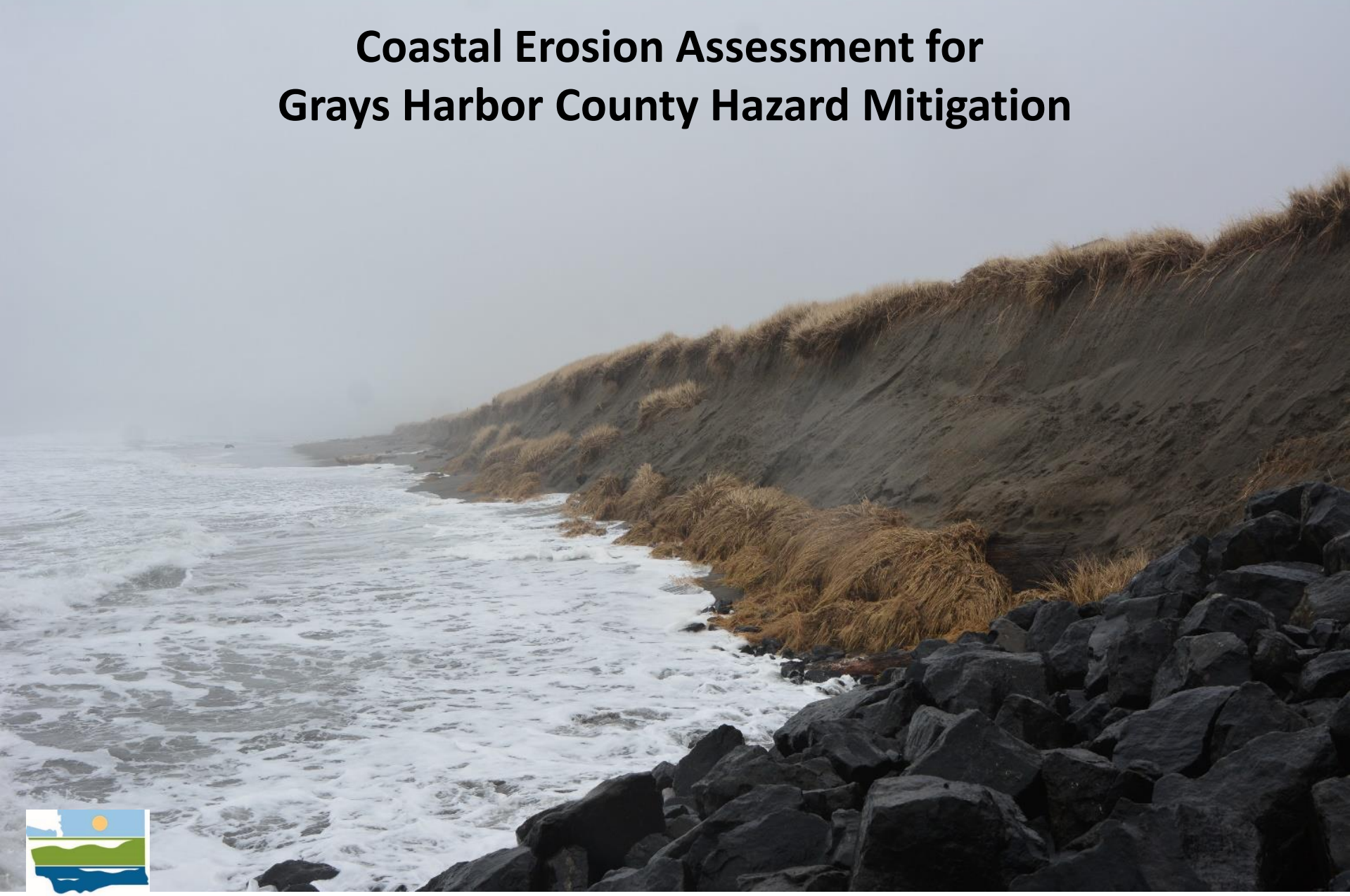
Slido access:

- Slido is a tool that allows you to submit your questions and express your opinion by sending your votes in via live polls.
- Each presentation will be 15 minutes long with 1-2 questions at the end (~3-5 minutes total). After the presentations, we will have 20 minutes for questions. Submit your questions or vote for them ("thumb up") using Slido anytime during the session. We will start the 20 minutes with the questions with the most "thumbs up."

To join:

1. Simply take out your smartphone or laptop and open your browser.
2. Go to **Slido.com** and enter the event code **#CHRN2019**.
3. You can now ask questions and up-vote the best ones.
4. If you have a question for a speaker in particular, make sure to mention their name.

Coastal Erosion Assessment for Grays Harbor County Hazard Mitigation



DEPARTMENT OF ECOLOGY
State of Washington

George Kaminsky, Diana McCandless, and Alex Rosen

Motivation

1. Despite the long history of coastal erosion impacts in Grays Harbor County, this hazard was never included in the County's Hazard Mitigation Plan.
2. Including coastal erosion in the County Plan provides a basis for local jurisdictions to develop additional information for their local plan.
3. The County and incorporated cities are eligible for project design funds to address the hazard.
4. The coastal erosion hazard profile for this relatively data rich area provides a model for content to be developed for other counties.
5. Ultimately, improved county hazard profiles improves the State Hazard Mitigation Plan.

Washington State

Enhanced Hazard Mitigation Plan

https://www.mil.wa.gov/other-links/enhanced-hazard-mitigation-plan

Effective 2018-2023

Approved 10/1/2018

Prepared by the Washington Emergency Management Division

http://www.co.grays-harbor.wa.us/departments/emergency_management/Hazard_Mitigation_Planning.php

Grays Harbor County
2018 Multi-Jurisdiction
Hazard Mitigation Plan Update
Volume 1: Planning-Area-Wide Elements

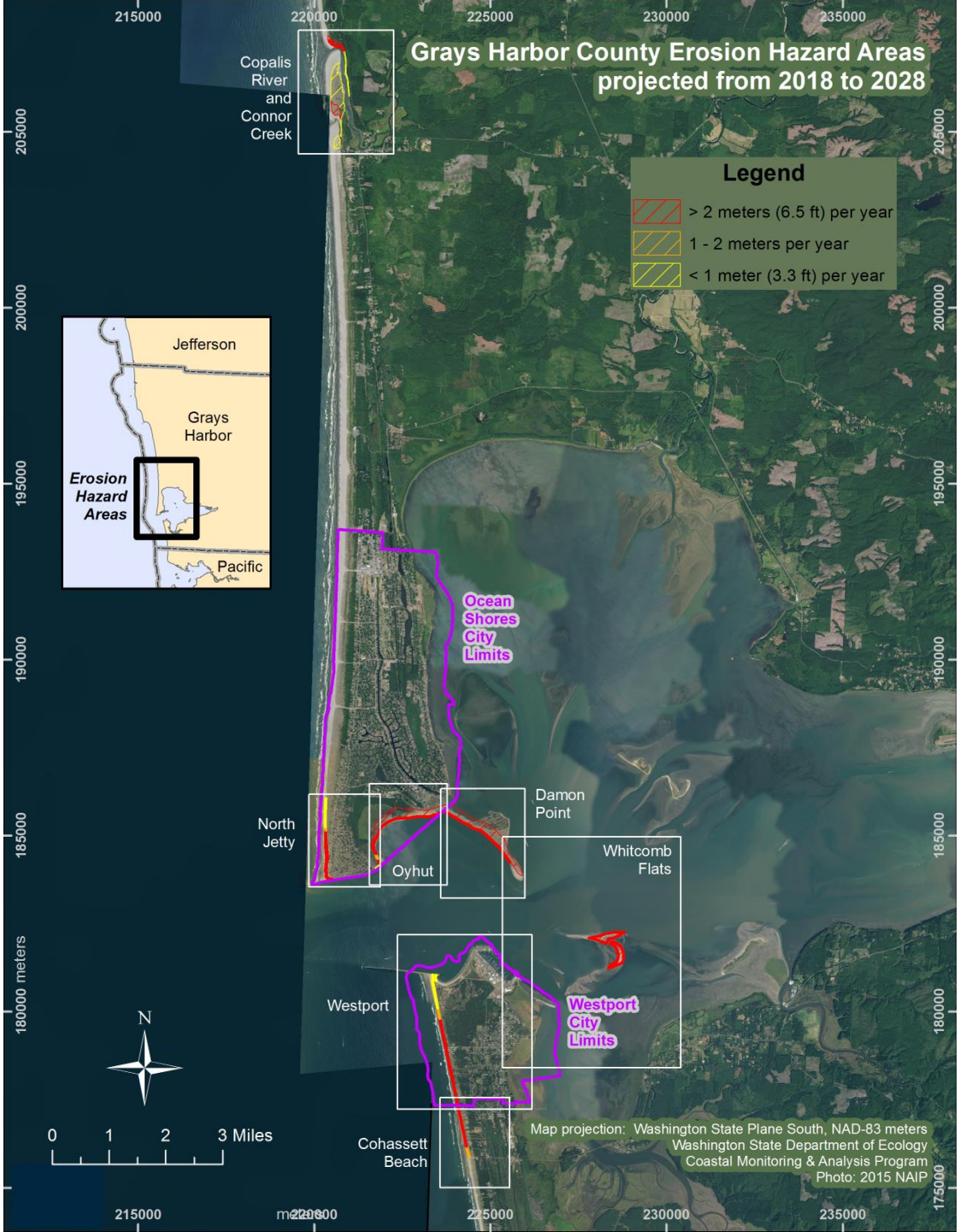
FINAL

July 2018

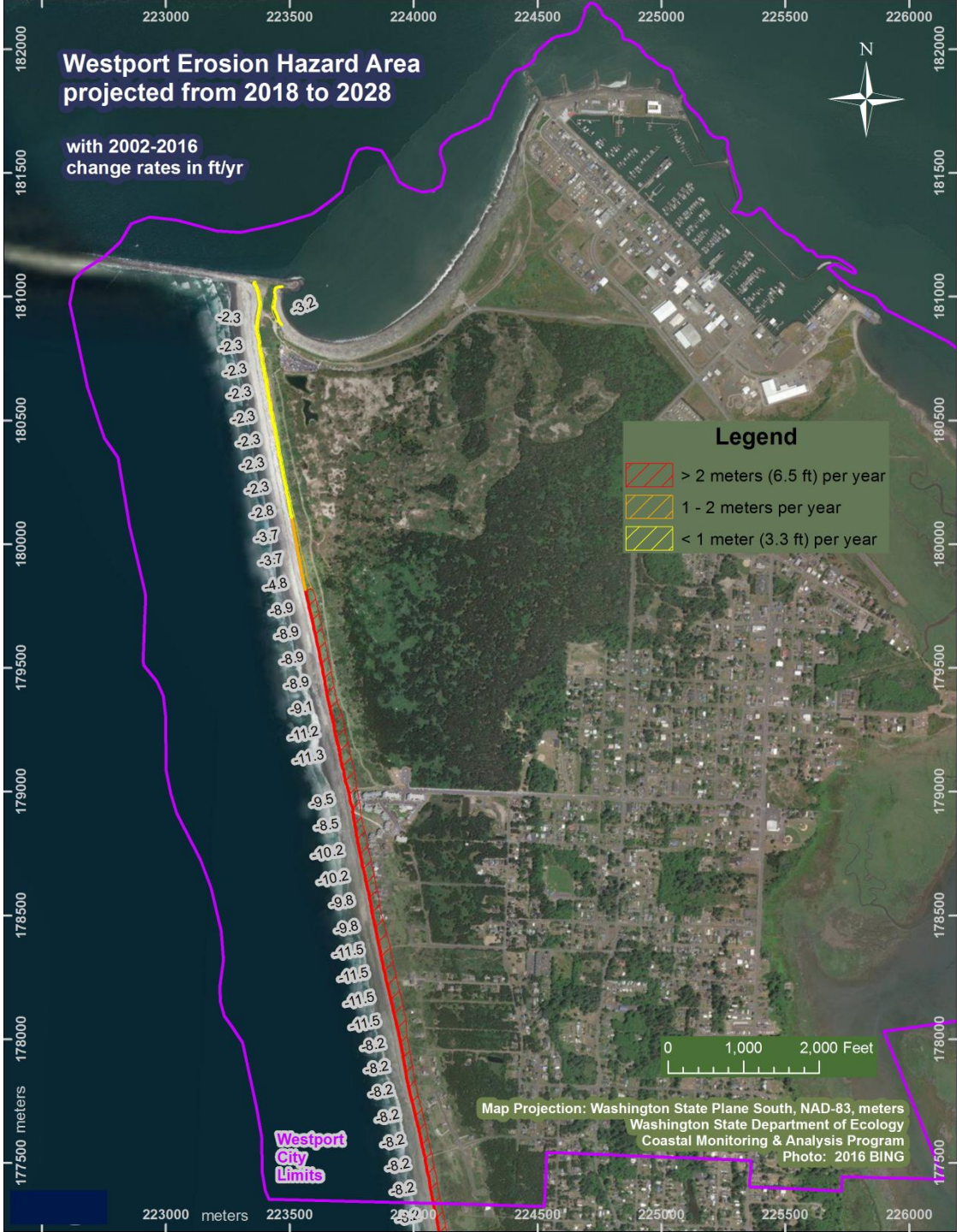
BRIDGEVIEW CONSULTING

Grays Harbor County Coastal Erosion Profile

1. General Background – What is coastal erosion, and how, when, and where does it occur?
2. Coastal erosion planning – consider a decade back and forward
3. Map and quantify EHAs – impacted structures, parcels, shoreline extent, acres
4. Document and describe previous occurrences of erosion
   a. For GHC, this includes coastal construction and mitigation history
5. Describe recent erosion events and conditions - causes, effects, and responses
6. Vulnerability Assessment – Impact on:
   a. Life, Health and Safety
   b. Property
   c. Critical Facilities and Infrastructure
   d. Economy
   e. Environment
7. Future Development Trends – needs and challenges


Grays Harbor County Erosion Hazard Areas
projected from 2018 to 2028
Legend
> 2 meters (6.5 ft) per year
1 - 2 meters per year
< 1 meter (3.3 ft) per year
Copalis River and Connor Creek
Jefferson
Grays Harbor
Erosion Hazard Areas
Pacific
Ocean Shores City Limits
North Jetty
Damon Point
Oyhut
Whitcomb Flats
Westport
Westport City Limits
Cohassett Beach
N
0 1 2 3 Miles
Map projection: Washington State Plane South, NAD-83 meters
Washington State Department of Ecology
Coastal Monitoring & Analysis Program
Photo: 2015 NAIP
215000
220000
225000
230000
235000
205000
200000
195000
190000
185000
180000
175000
meters

Summary Inventory of Grays Harbor Erosion Hazard Areas						
Jurisdiction & Name of Area	Number of Structures	Number of Parcels	Length of Shoreline (km)	(miles)	Number of Acres	Other
City of Ocean Shores						
North Jetty area	13	31	2.53	1.57	16.9	
Oyhut Wildlife Recreation Area	20	30	3.28	2.04	139.9	Also Sewage Treatment Plant, Marine View Dr SE
Subtotal	**33**	**61**	**5.81**	**3.61**	**156.8**	
City of Westport						
Westport	9	49	4.00	2.49	25.6	Excluded in the parcel count are: 4 large State Parks parcels, 2 City of Westport parcels
Subtotal	**9**	**49**	**4.00**	**2.49**	**25.6**	
Grays Harbor County						
Copalis River & Connor Creek	3	24	3.73	2.32	141.7	
Cohassett Beach	0	1	1.49	0.93	9.6	
Whitcomb Flats	0	0	4.39	2.73	63.5	
Damon Point	0	0	2.49	1.55	150.2	Affects access to a recreation area
Subtotal	**3**	**25**	**12.10**	**7.52**	**365.0**	
Total	**45**	**135**	**21.91**	**13.62**	**547.4**	


Westport Erosion Hazard Area
projected from 2018 to 2028
with 2002-2016
change rates in ft/yr
N
Legend
> 2 meters (6.5 ft) per year
1 - 2 meters per year
< 1 meter (3.3 ft) per year
-3.2
-2.3
-2.3
-2.3
-2.3
-2.3
-2.3
-2.3
-2.3
-2.3
-2.8
-3.7
-3.7
-4.8
-8.9
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-9.1
-11.2
-11.3
-9.5
-8.5
-10.2
-10.2
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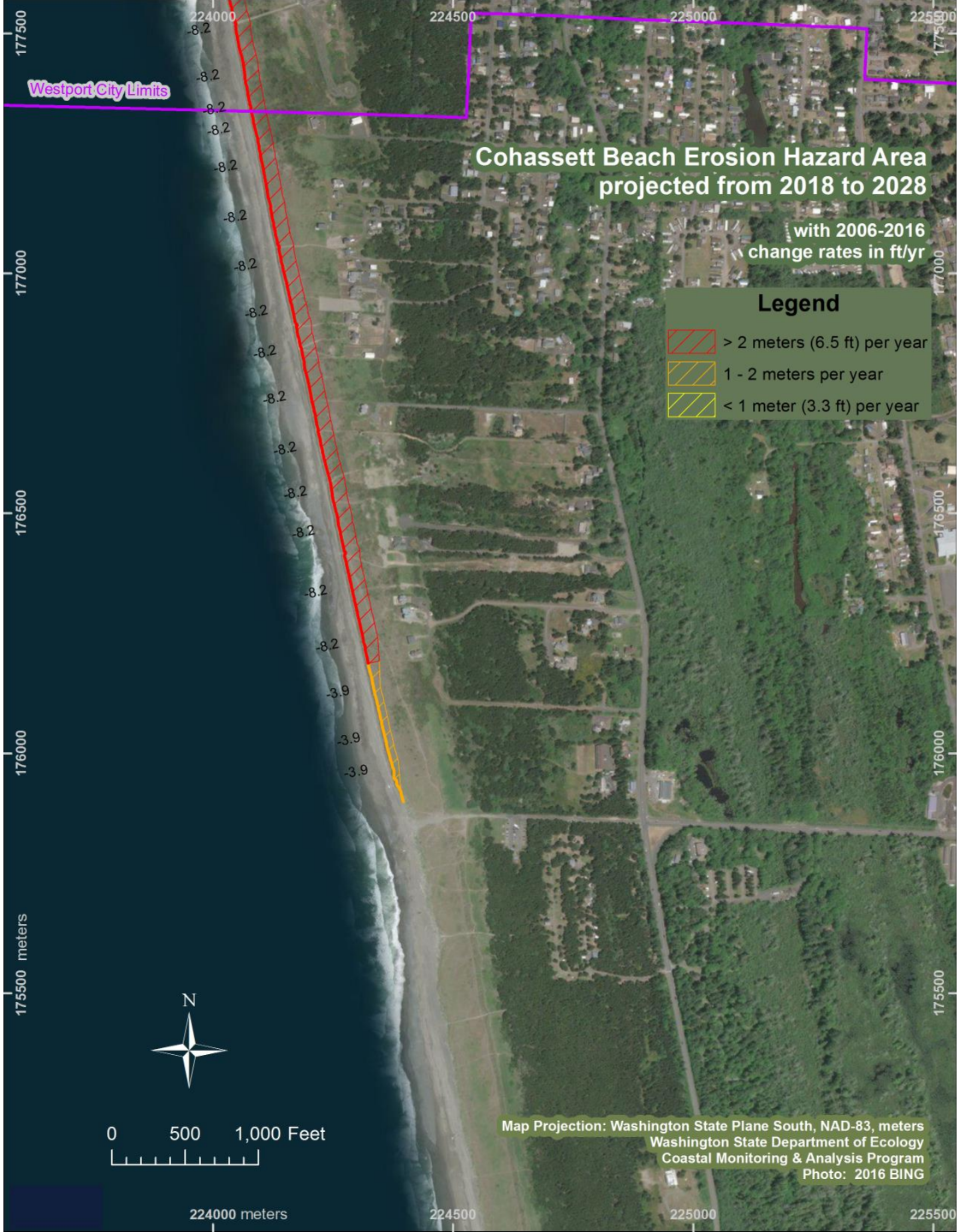
-8.2
-8.2
-8.2
-8.2
-8.2
-8.2
-8.2
-8.2
0
1,000
2,000 Feet
Map Projection: Washington State Plane South, NAD-83, meters
Washington State Department of Ecology
Coastal Monitoring & Analysis Program
Photo: 2016 BING
Westport
City
Limits
223000
223500
224000
224500
225000
225500
226000
182000
181500
181000
180500
180000
179500
179000
178500
178000
177500
meters


Westport City Limits
Cohassett Beach Erosion Hazard Area
projected from 2018 to 2028
with 2006-2016
change rates in ft/yr
Legend
> 2 meters (6.5 ft) per year
1 - 2 meters per year
< 1 meter (3.3 ft) per year
-8.2
-3.9
224000
224500
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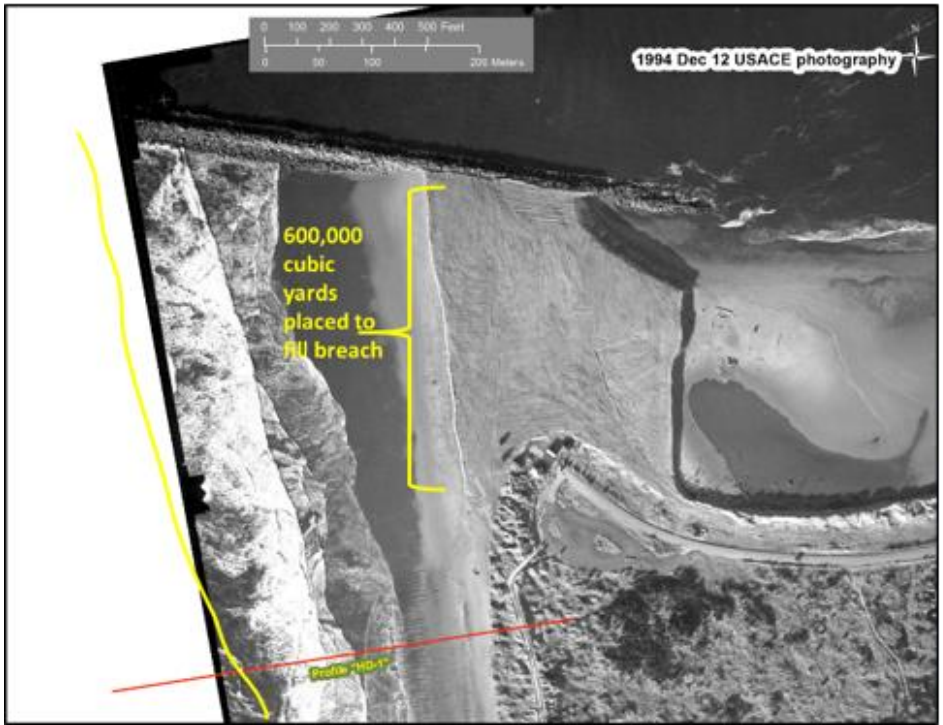
225500
177500
177000
176500
176000
175500 meters
224000 meters
N
0 500 1,000 Feet
Map Projection: Washington State Plane South, NAD-83, meters
Washington State Department of Ecology
Coastal Monitoring & Analysis Program
Photo: 2016 BING

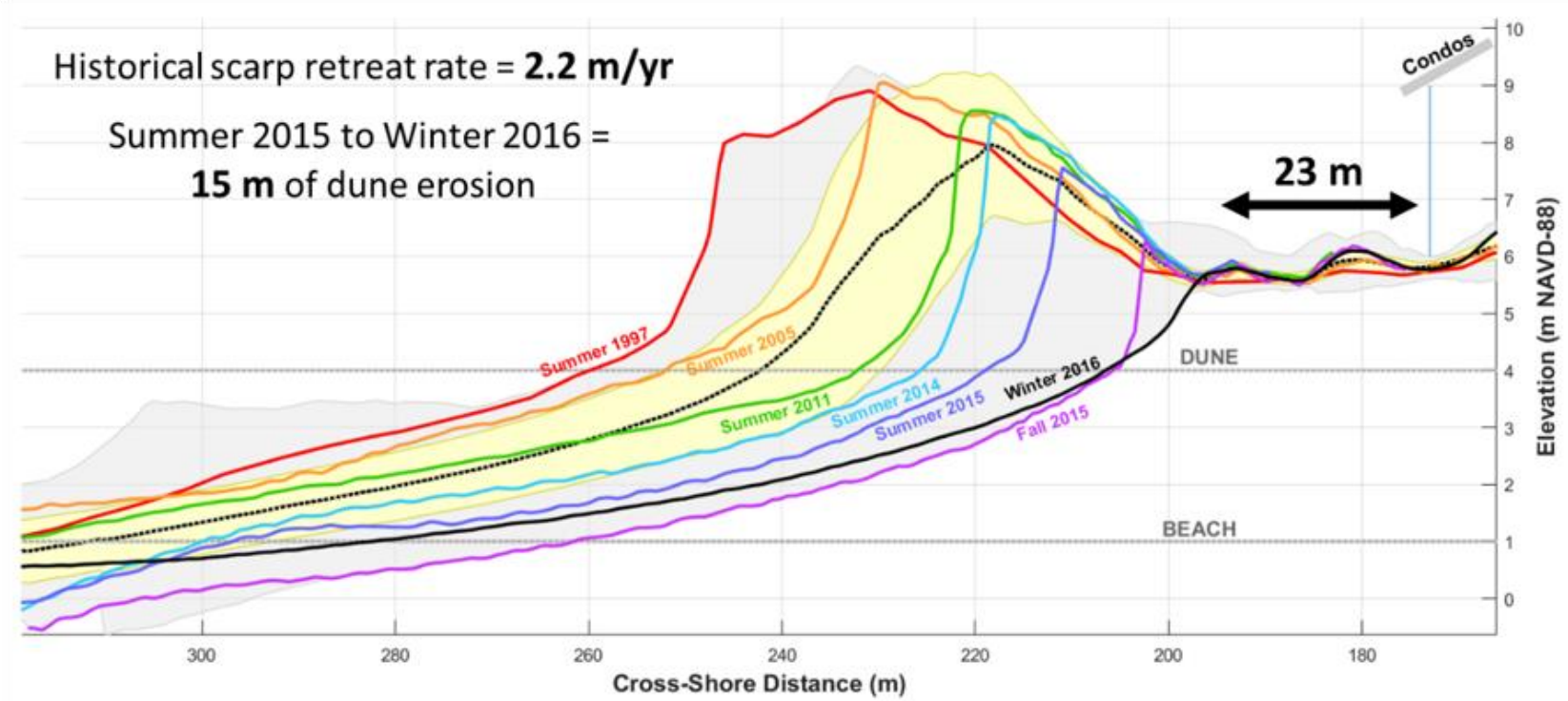

1967 WaDNR photography
1256 feet
(383 meters)
Profile "HD-1"


1994 Mar 6 USACE photography
Profile "HD-1"


1994 Dec 12 USACE photography
600,000
cubic
yards
placed to
fill breach
Profile "HD-1"


2010 BING Photography
656 ft of
retreat at
15.3 ft/yr
over
43 years
Profile "HD-1"
bing

Profile “Worm”



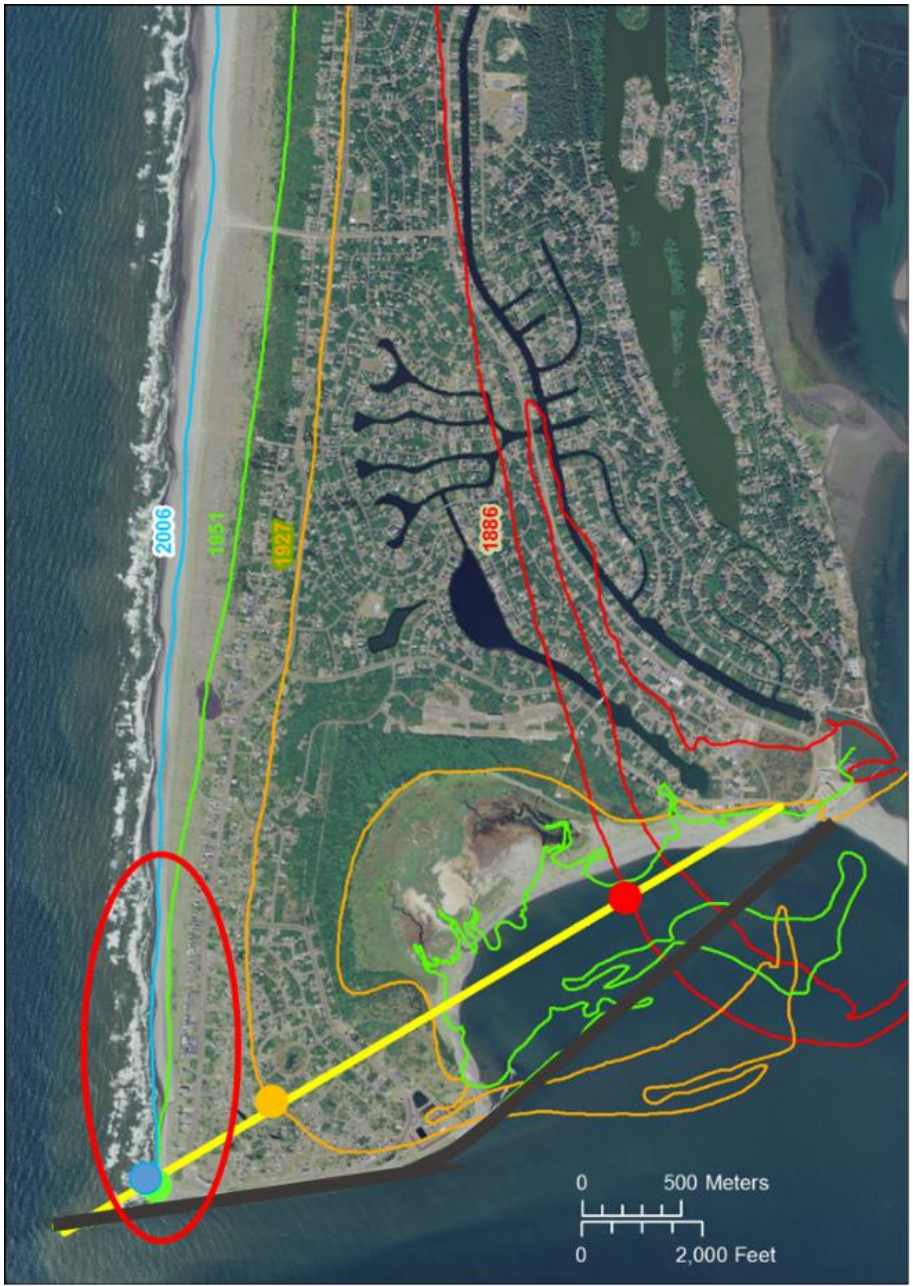
History of Beach and Nearshore Nourishment in Grays Harbor County

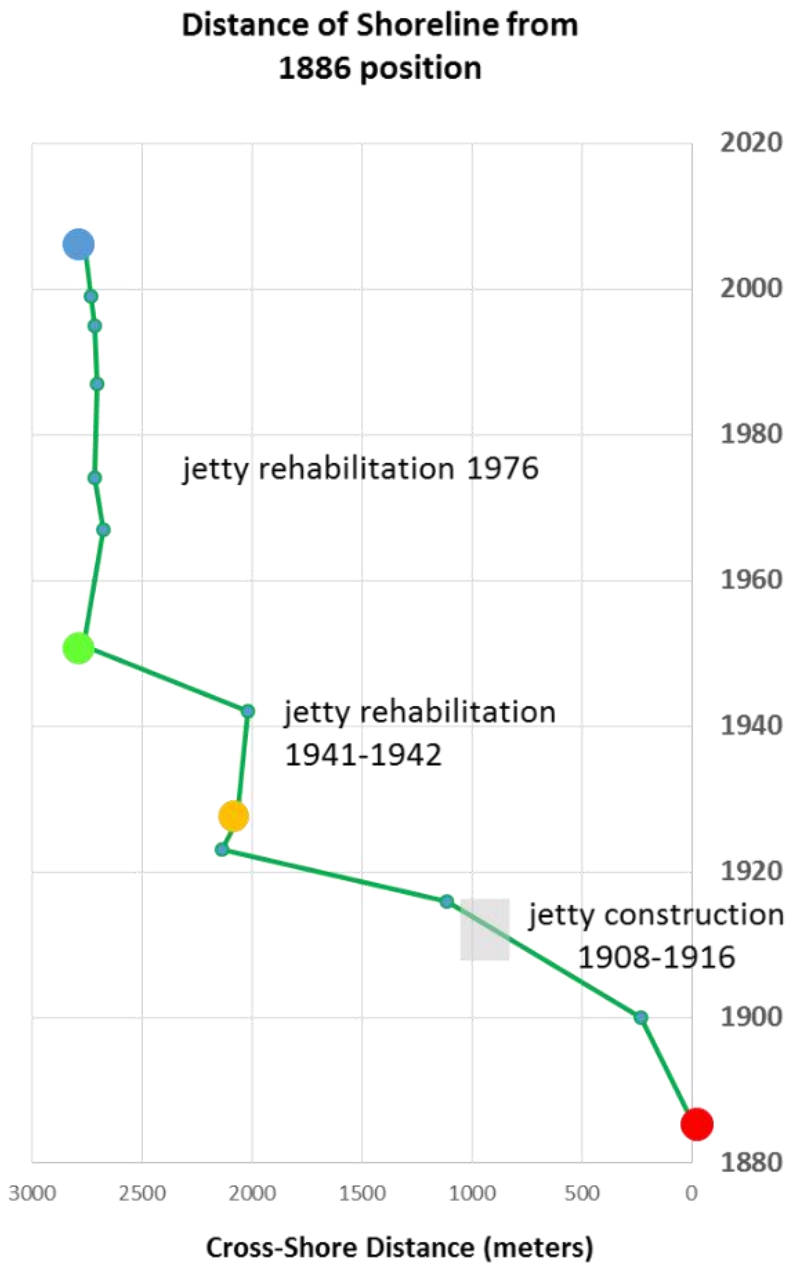
Year	Nearshore Sites		Beach Sites				Description of Beach Nourishment
	South Beach (cy)	Half Moon Bay (cy)	Breach Fill (cy)	Half Moon Bay (cy)	Westport (cy)	Ocean Shores (cy)	
1992		200,000					
1993	373,000						
1994	265,000	146,000	600,000				600,000 cy sand to fill the breach
1995				300,295	82,000		300,295 cy sand south of revetment; 82,000 cy sand at City outfall
1996		274,780					
1997		308,604		5,000			5,000 cy sand at HMB shoreline berm south of revetment
1998		421,468					
1999	76,187	228,470		228,963			228,963 cy sand at revetment extension beach fill
2000			11,600				11, 600 cy of 12" minus cobble and gravel along HMB Breach Fill
2001			16,100				16,100 cy of 12" minus cobble and gravel along HMB Breach Fill
2002	75,219	378,441	135,000				135,000 cy sand at HMB
2003	125,388	329,106			1,700		1,700 cy sand at HMB beach along dune trail
2004	262,176	289,652	29,553				29,553 cy sand at HMB Breach Fill
2005	217,909	102,184	22,779				22,779 cy sand at SB at Breach Fill
2006	55,170	126,892					
2007		140,406					
2008		171,353					
2009	214,502	144,975					
2010	118,182	91,720	30,000				10,000 cy sand at HMB Breach Fill; 20,000 cy sand at SB Breach Fill
2011	298,251	177,150					
2012	142,313	111,205	30,000				30,000 cy sand from upland source to Breach Fill
2013	477,637	86,147					
2014	498,440						
2015	506,330					3,350	1,600 cy of sand + 1,750 cy of sand placed in front of geotubes
2016	544,980						
2017	499,001	101,019					
Sum	**4,749,685**	**3,829,572**	**875,032**	**534,258**	**83,700**	**3,350**	
	Total Nearshore		**Total Beach**				**Total Nourishment**
	8,579,257		**1,496,340**				**10,075,597**

Westport Summary

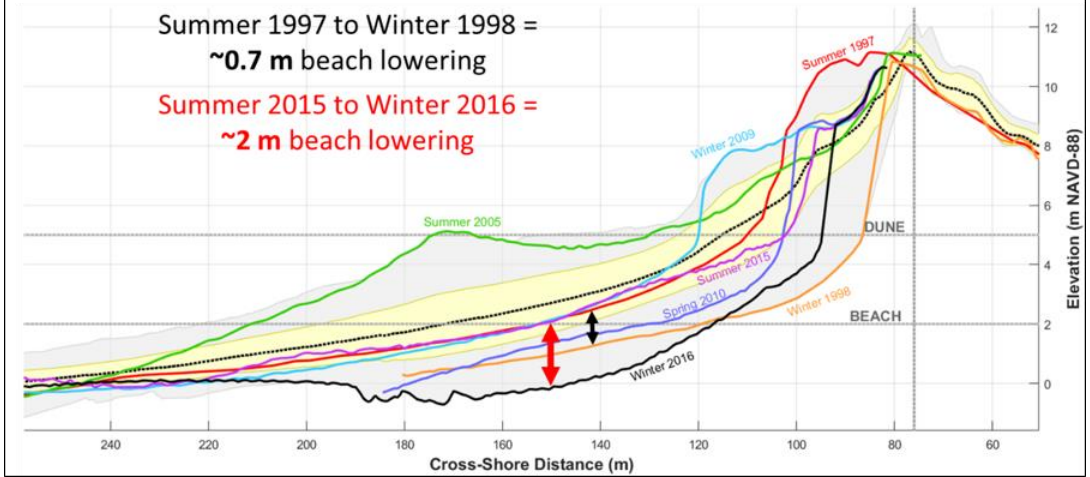
- The South Beach shoreline along Westport and Cohassett Beach are experiencing a sediment deficit that is not likely to be augmented by natural processes
- Loss of dune and coastal erosion threatens condominiums and houses fronting Dune Crest Drive
- Dune erosion scarp extends from the jetty to 5.1 km south along shoreline
- Shoreline position is dependent on jetty breach fill condition
- Average erosion of 63,100 cubic yards/year of sediment from beaches and dunes
- Beach and dune nourishment in Westport is essential to avoid catastrophic losses to upland development and infrastructure
- The maintenance of the Half Moon Bay shoreline is relatively intense, consisting of routine nearshore and beach nourishment, and relatively routine repair of the Point Chehalis revetment.


North Jetty Erosion Hazard Area
projected from 2018 to 2028
with 2006-2016
change rates in ft/yr
Legend
> 2 meters (6.5 ft) per year
1 - 2 meters per year
< 1 meter (3.3 ft) per year
N
220000
220500
221000
221500
186000
185500
185000
184500
184000
meters
-2.6
-2.6
-2.6
-2.6
-2.6
-2.6
-1
-1
-3.6
-7.1
-8.5
-8.5
-13.1
-13.1
-13.8
-13.8
-16.1
-16.1
-9.8
-11.8
-11.8
-11.8
-9
-9.2
-9.2
-20.3
-16.8
-14.3
-11.9
-6.9
0
500
1,000 Feet
Map Projection: Washington State Plane South, NAD-83, meters
Washington State Department of Ecology
Coastal Monitoring & Analysis Program
Photo: 2015 NAIP


2006
1951
1927
1886
0
500 Meters
0
2,000 Feet


Distance of Shoreline from 1886 position
jetty rehabilitation 1976
jetty rehabilitation 1941-1942
jetty construction 1908-1916
2020
2000
1980
1960
1940
1920
1900
1880
3000
2500
2000
1500
1000
500
0
Cross-Shore Distance (meters)

Profile “X1 South”




PRIVATE
PROPERTY
July 5, 2008


November 9, 2015


DEERE
Geobags

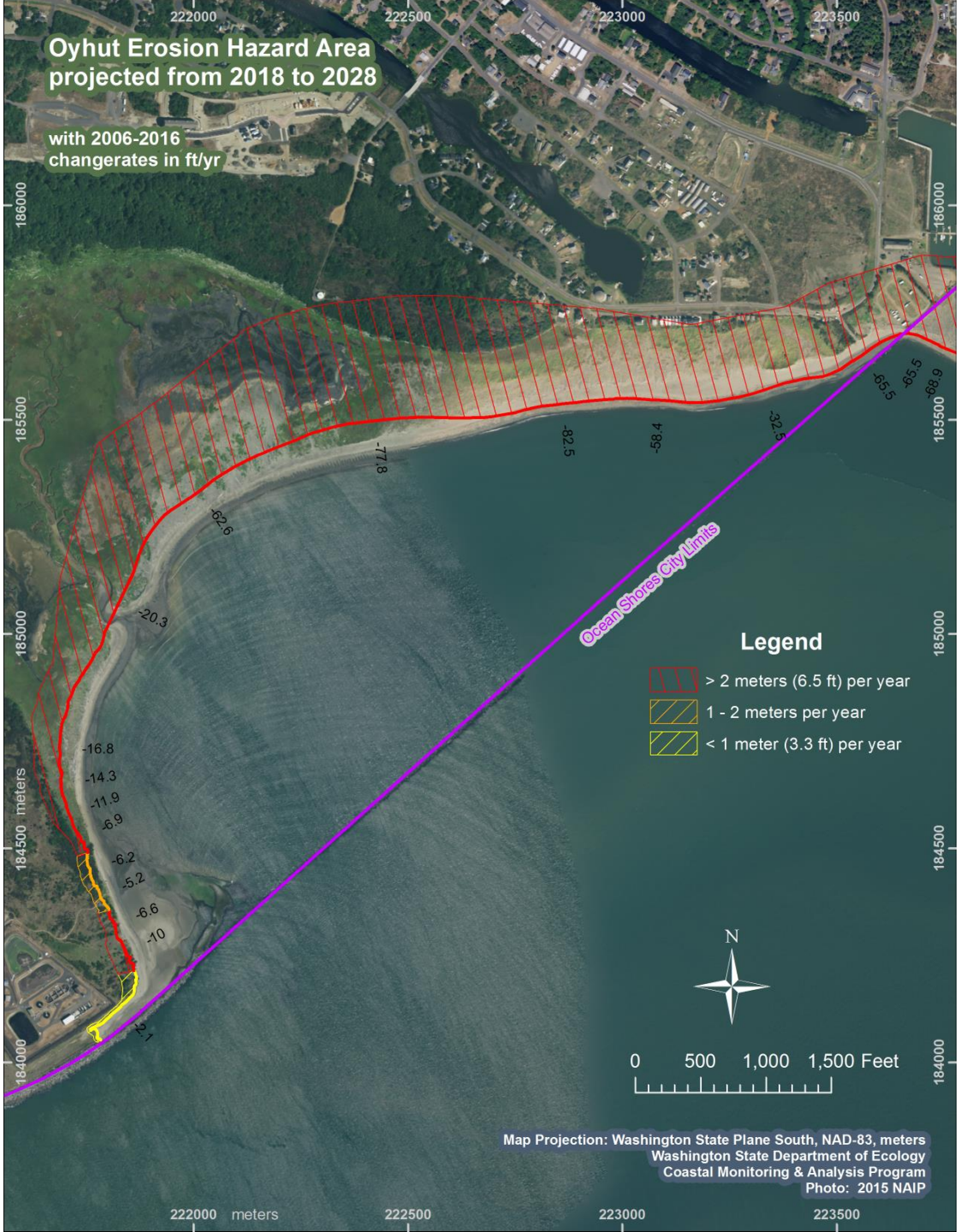

Nourishment
November 2, 2015
Photo courtesy of Nick Bird, City of Ocean Shores


November 9, 2015
Nourishment


March 8, 2016
Rock revetment


June 4, 2016
End scour


N
100 m
Google Earth imagery (8/17/2016)

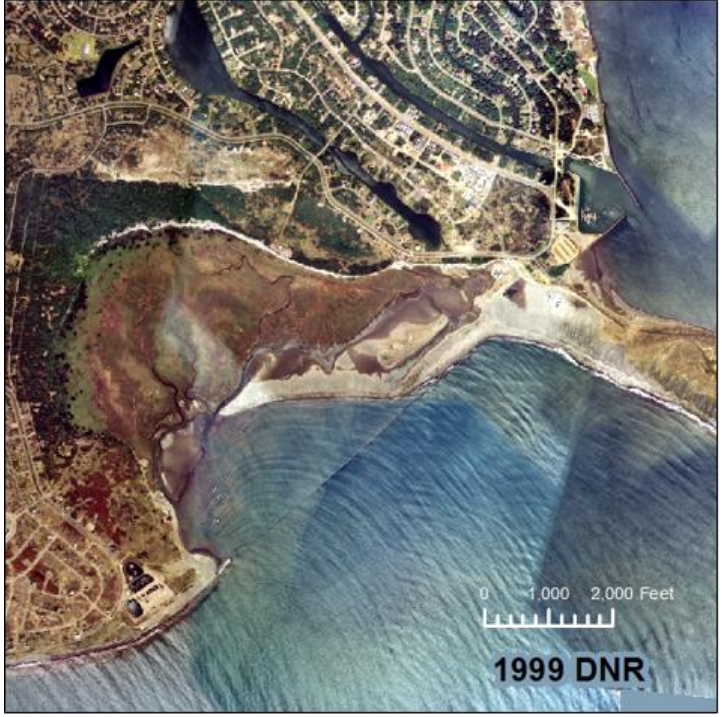

Oyhut Erosion Hazard Area
projected from 2018 to 2028
with 2006-2016
changerates in ft/yr
222000
222500
223000
223500
186000
185500
185000
184500
184000
meters
-77.8
-82.5
-58.4
-32.5
-65.5
-65.5
-68.9
-62.6
-20.3
-16.8
-14.3
-11.9
-6.9
-6.2
-5.2
-6.6
-10
-12.1
Ocean Shores City Limits
Legend
> 2 meters (6.5 ft) per year
1 - 2 meters per year
< 1 meter (3.3 ft) per year
N
0 500 1,000 1,500 Feet
Map Projection: Washington State Plane South, NAD-83, meters
Washington State Department of Ecology
Coastal Monitoring & Analysis Program
Photo: 2015 NAIP

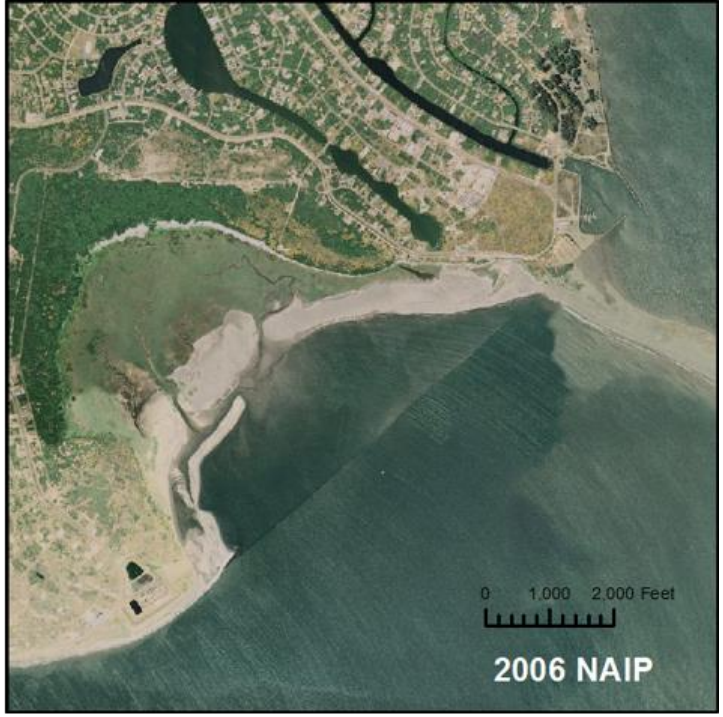

0 1,000 2,000 Feet
1967 DNR


0 1,000 2,000 Feet
1974 DNR


0 1,000 2,000 Feet
1981 DNR


0 1,000 2,000 Feet
1990 DNR


0 1,000 2,000 Feet
1999 DNR


0 1,000 2,000 Feet
2006 NAIP


0 1,000 2,000 Feet
2011 NAIP

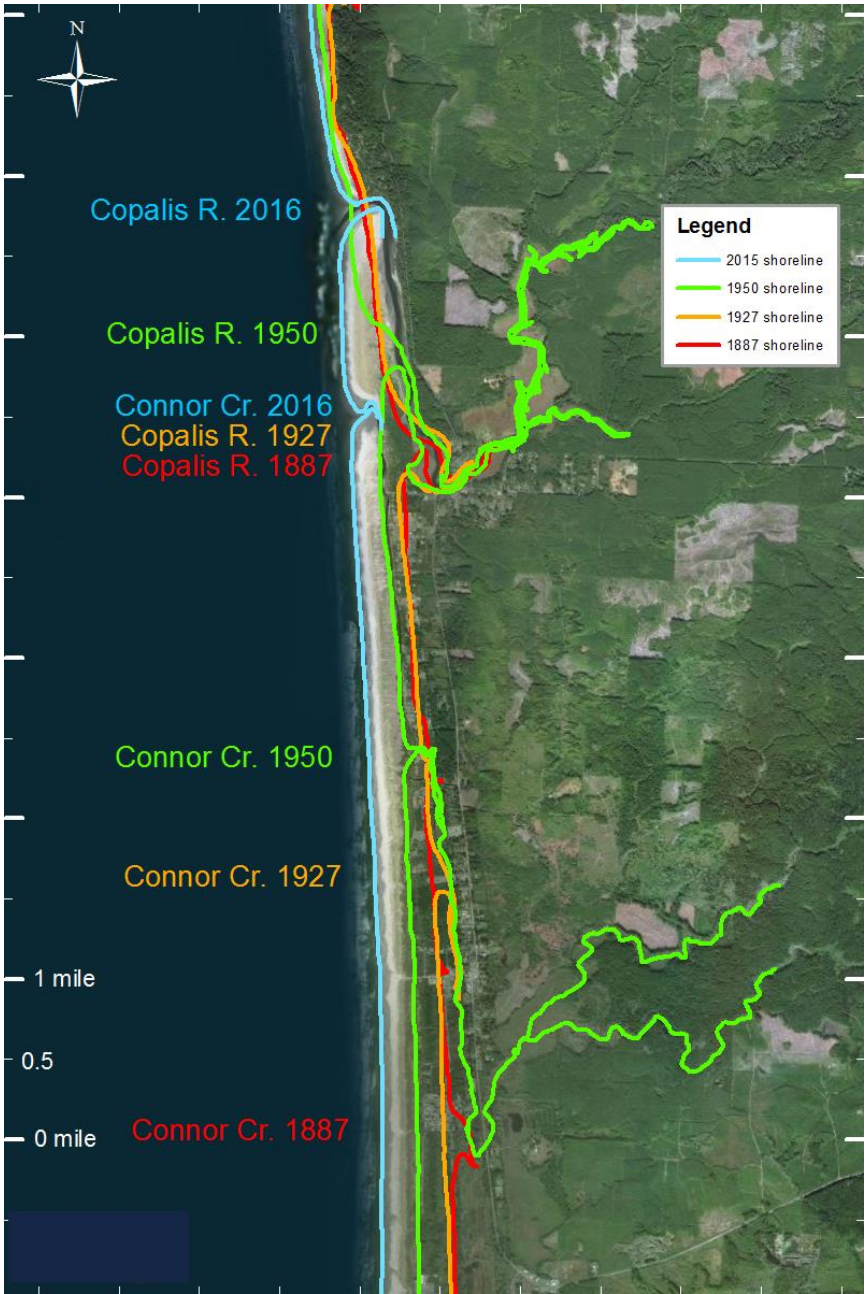

0 1,000 2,000 Feet
2015 NAIP


Damon Point Erosion Hazard Area
projected from 2018 to 2028
with 2006-2016
change rates in ft/yr
Ocean Shores City Limits
-65.5
-68.9
-65.9
-59.8
-58.6
-66.6
-71.9
-73.7
-71.6
-65.5
-44.5
Legend
> 2 meters (6.5 ft) per year
1 - 2 meters per year
< 1 meter (3.3 ft) per year
N
0 500 1,000 1,500 Feet
Map Projection: Washington State Plane South, NAD-83, meters
Washington State Department of Ecology
Coastal Monitoring & Analysis Program
Photo: 2015 NAIP
224000 224500 225000 225500
meters
186000
185500
185000
184500
184000
183500

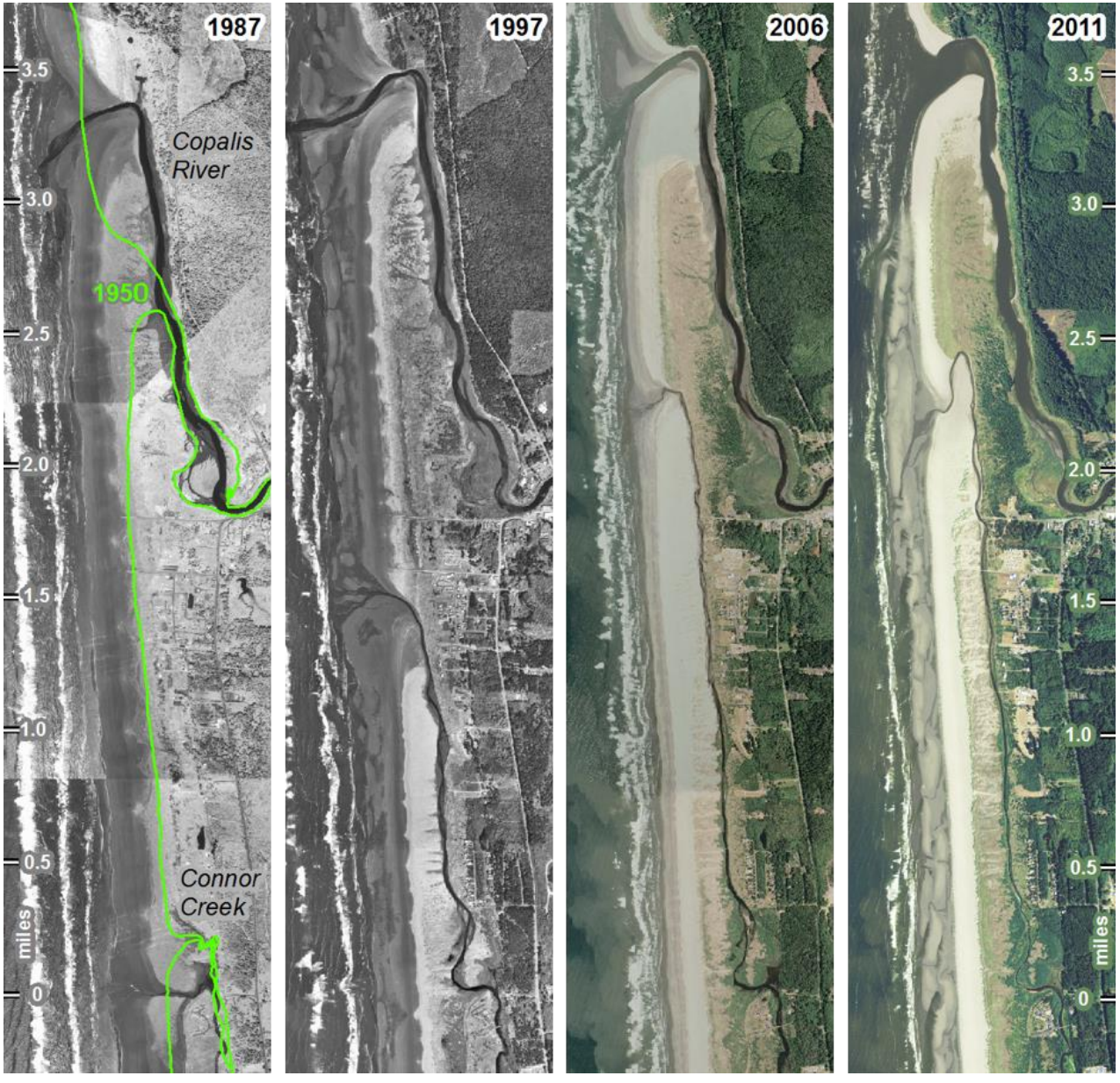
Oyhut Bay and Quinault Marina Summary

- Long term erosion threatens loss of RV and marina facilities and boat access
- Overwash of Damon Spit and sedimentation of Marina and boat access channel
- Damon Spit becoming narrower, flatter, and migrating toward Marina
- Long term viability of Marina will require considerable engineering and maintenance dredging
- The Marina breakwater and the eastward end of the maintained North Jetty near the wastewater treatment plant provide anchor points that control the equilibrium location of the Oyhut Bay shoreline.
- More study is needed to develop a long-term prediction of the Oyhut shoreline and the relative importance of the anchor point at the Quinault Marina.

Copalis River and Connor Creek – Mouth Migration



Copalis River and Connor Creek – Mouth Migration



FEMA's Coastal Flood Mapping Efforts

Ted Perkins, PE

Regional Engineer

FEMA Region 10

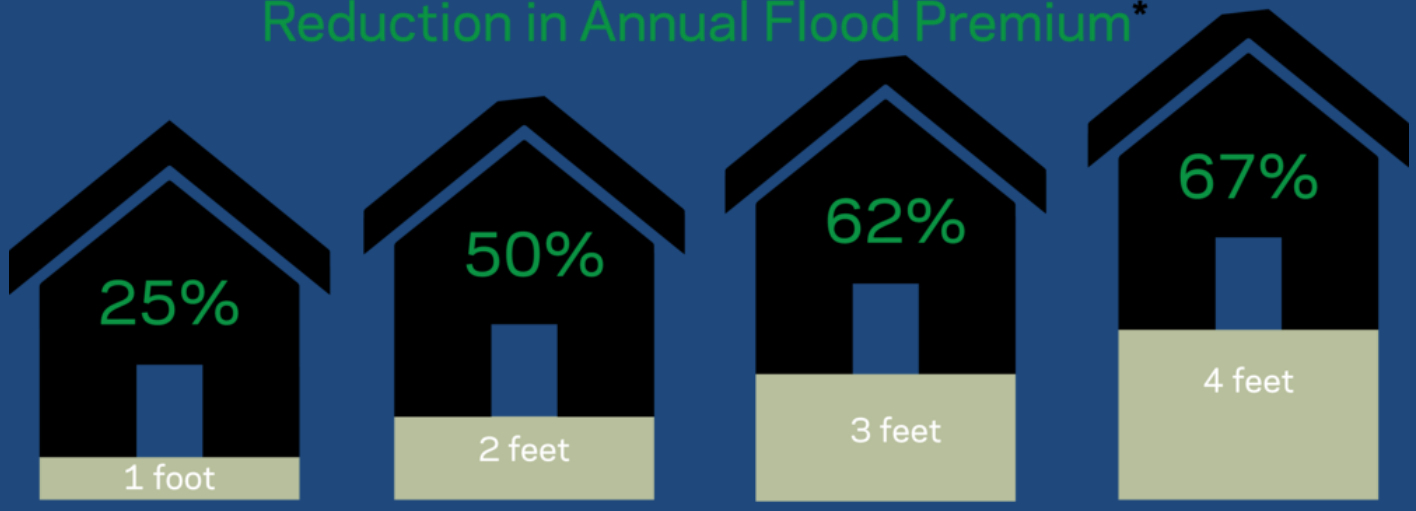
June 5, 2019

FEMA

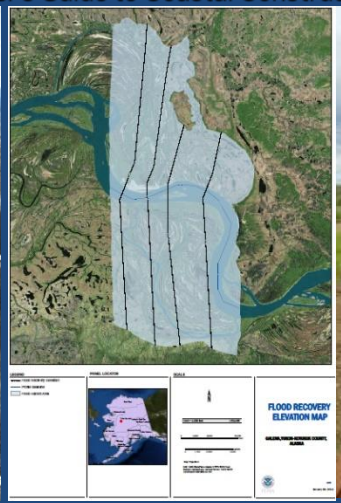
Outline

- Background of the National Flood Insurance Program
- Regional Coastal Flood Study Efforts

Purpose of the National Flood Insurance Program (NFIP)



* Example: V-Zone building with an open foundation. $250,000 building coverage, $100,000 contents coverage. Reductions compared to lowest flood at BFE. Note: This does not include recent rate increases. (FEMA Home Builder's Guide to Coastal Construction)



Basis for Floodplain Mapping

250,000 Rivers in US – on average 2,500 rivers are seeing the 1% flood or greater every year

3,500,000 Miles of River – on average 35,000 miles of river are seeing the 1% flood or greater every year.

42,500 Miles of Coastline are mapped – on average 425 miles of coastline are seeing the 1% flood or greater every year.

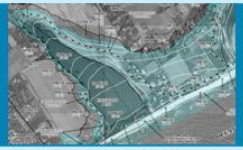
RiskMAP, the NFIP and Hazard Mitigation Planning

RiskMAP

Increasing Resilience Together

Goals

Deliver High-Quality Risk Data



Products

- Intuitive Flood Maps
- Credible data- reliable, accurate, watershed-based
- Illustrations of Flood Depths
- Valuable Flood Risk Assessments

Increase Awareness of Flood Risk

- Tools to understand how flood risk has changed
- Continuous engagement with communities
- Enable communities to communicate flood risk to constituents

Promote Community Mitigation Actions

Support that allows communities to identify and risks and promote:

- Community resiliency
- Sustainability
- Reduced need for federal disaster assistance

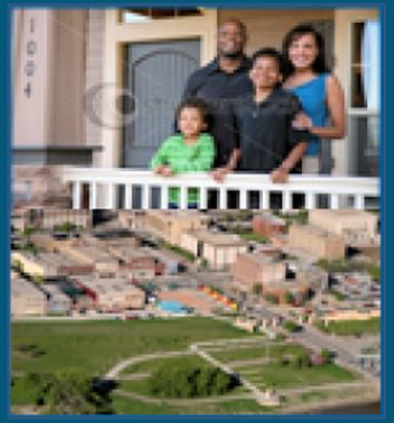
Processes

MITIGATION PLANNING

Enhance delivery of Risk MAP Products

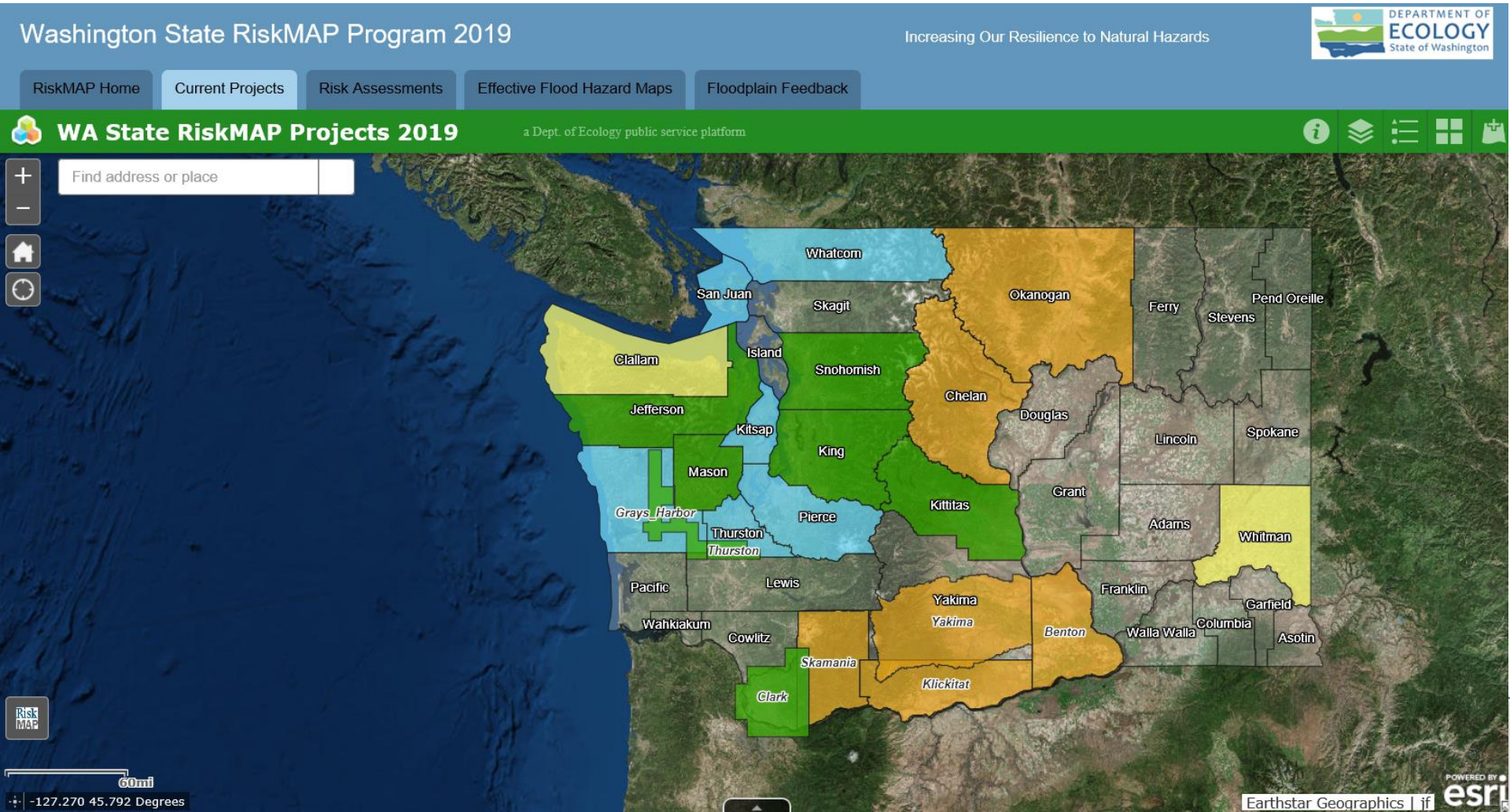
Collaborate across all levels of government

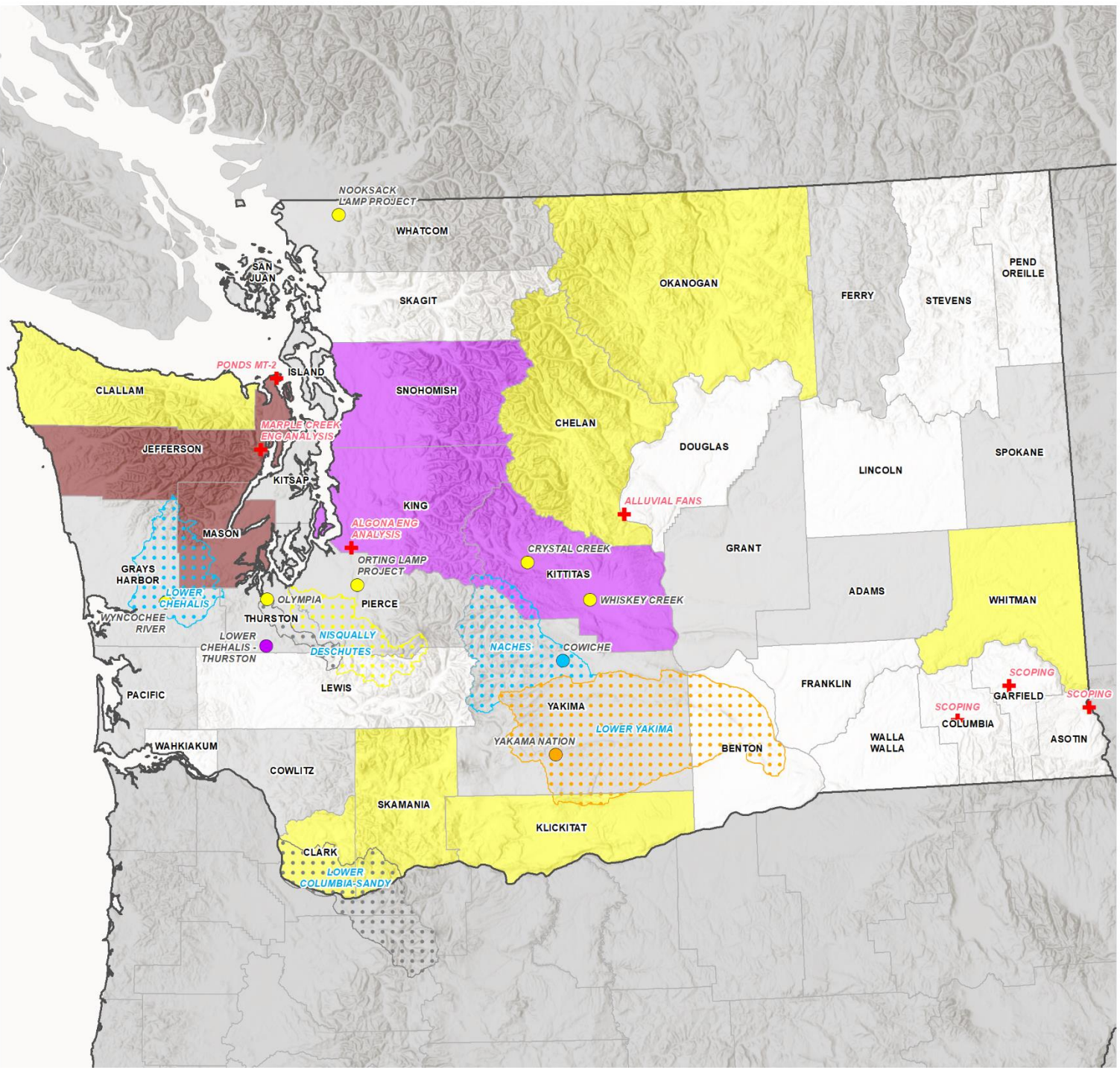
Reduce Risk to Lives and Property



Washington Risk MAP Website

https://waecy.maps.arcgis.com/apps/MapSeries/index.html?appid=8451cb0db0c4461182e592eb5a43400a





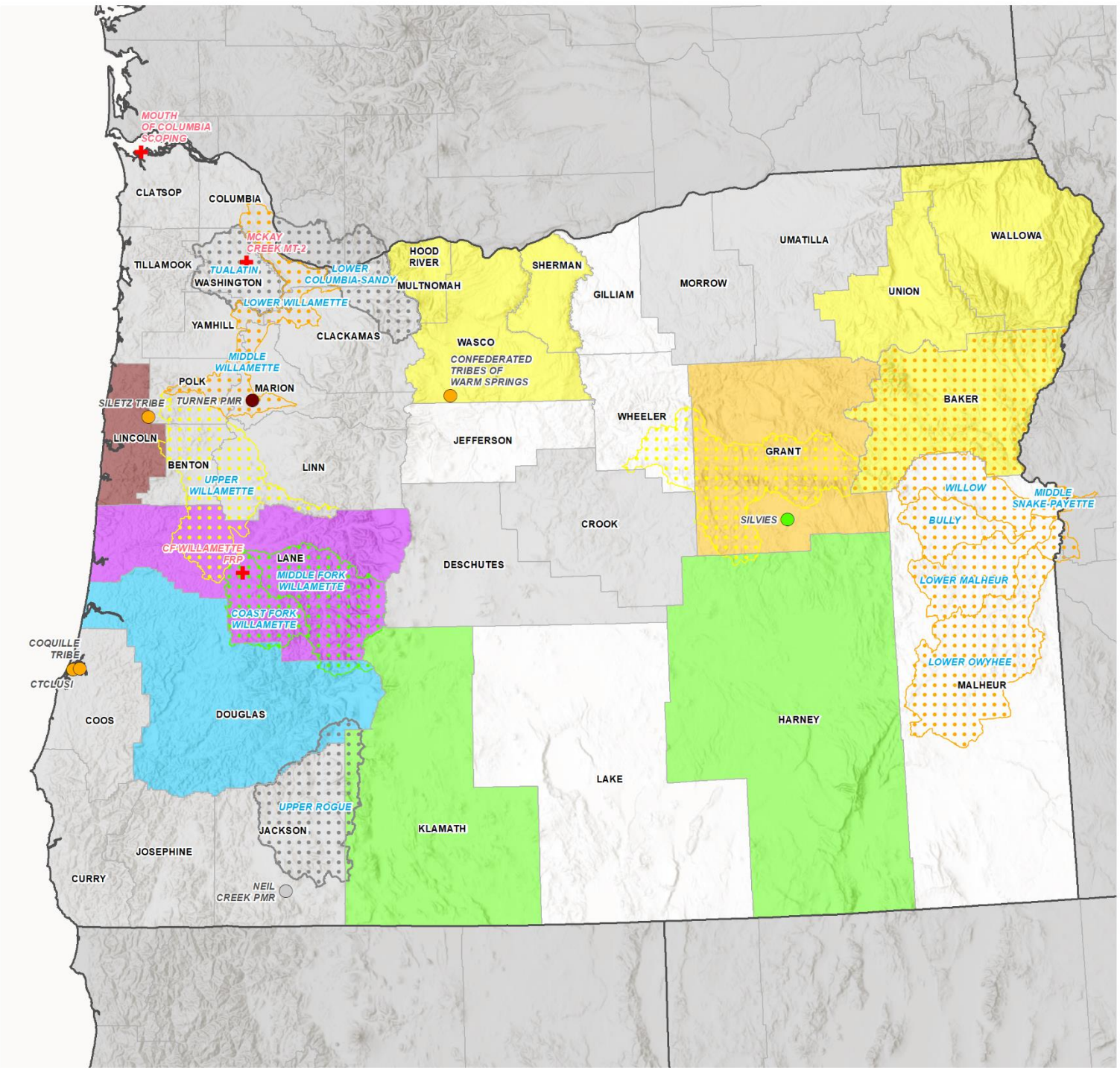
WASHINGTON

STATUS MAP

2019.05

	LOCAL	WATERSHED	COUNTY
NOT MODERNIZED	NOT SHOWN	NOT SHOWN	
FUNDED PROJECT STATUS: DISCOVERY			
FUNDED PROJECT STATUS: IN-PROGRESS			
FUNDED PROJECT STATUS: DRAFT			
FUNDED PROJECT STATUS: PRELIMINARY			
FUNDED PROJECT STATUS: APPEAL START			
FUNDED PROJECT STATUS: LFD			
MODERNIZED			

REGION/RSC INITIATIVES

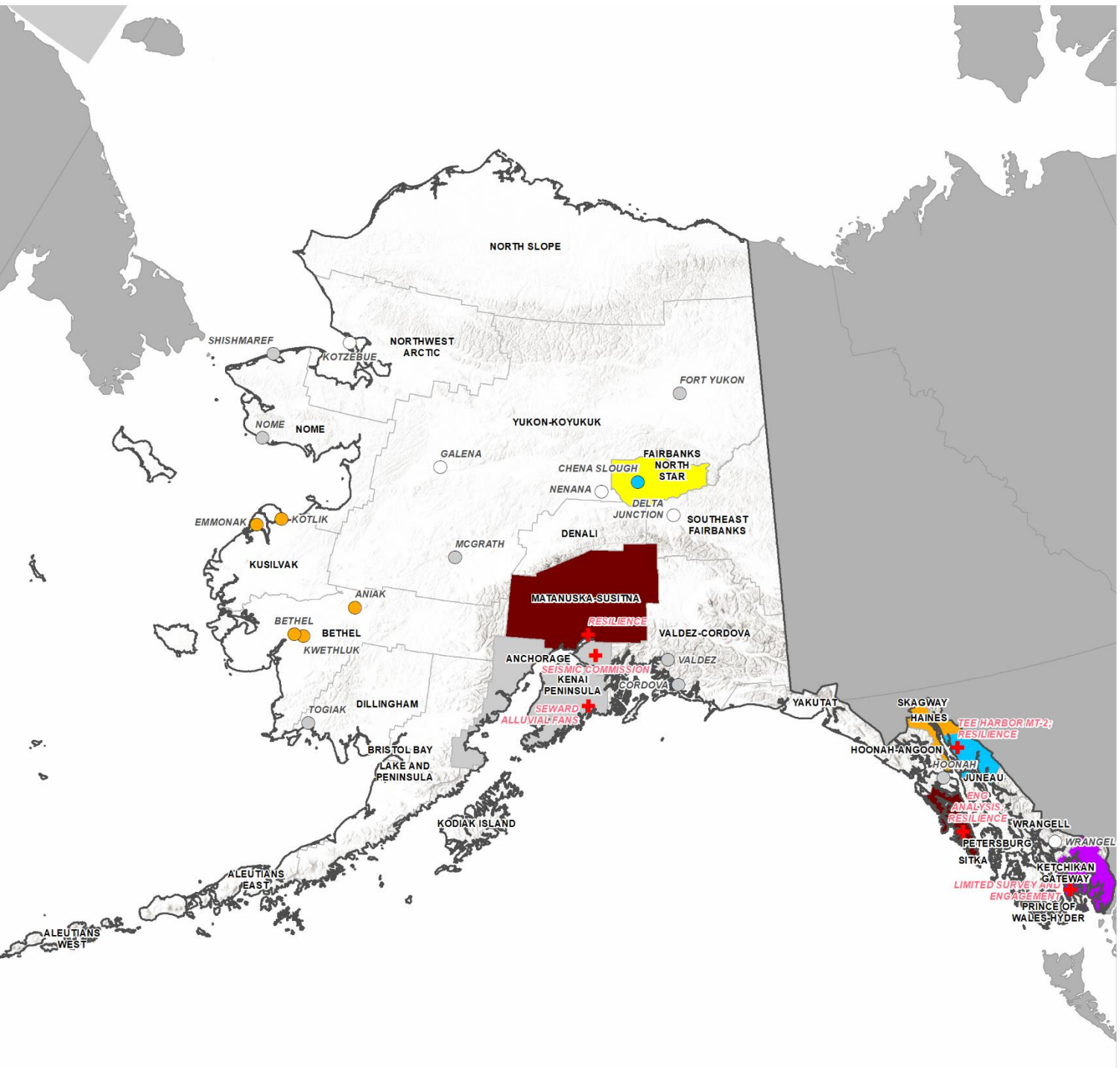


OREGON

STATUS MAP

2019.05

	LOCAL	WATERSHED	COUNTY
NOT MODERNIZED	NOT SHOWN	NOT SHOWN	
FUNDED PROJECT STATUS: DISCOVERY			
FUNDED PROJECT STATUS: IN-PROGRESS			
FUNDED PROJECT STATUS: DRAFT			
FUNDED PROJECT STATUS: PRELIMINARY			
FUNDED PROJECT STATUS: APPEAL START			
FUNDED PROJECT STATUS: LFD			
MODERNIZED			
REGION/RSC INITIATIVES			



ALASKA

STATUS MAP

2019.05

	LOCAL	WATERSHED	BOROUGH/ CENSUS AREA
NOT MODERNIZED	○	NOT SHOWN	
FUNDED PROJECT STATUS: DISCOVERY	●	▨	■
FUNDED PROJECT STATUS: IN-PROGRESS	●	▨	■
FUNDED PROJECT STATUS: DRAFT	●	▨	■
FUNDED PROJECT STATUS: PRELIMINARY	●	▨	■
FUNDED PROJECT STATUS: APPEAL START	●	▨	■
FUNDED PROJECT STATUS: LFD	●	▨	■
MODERNIZED	○	▨	■

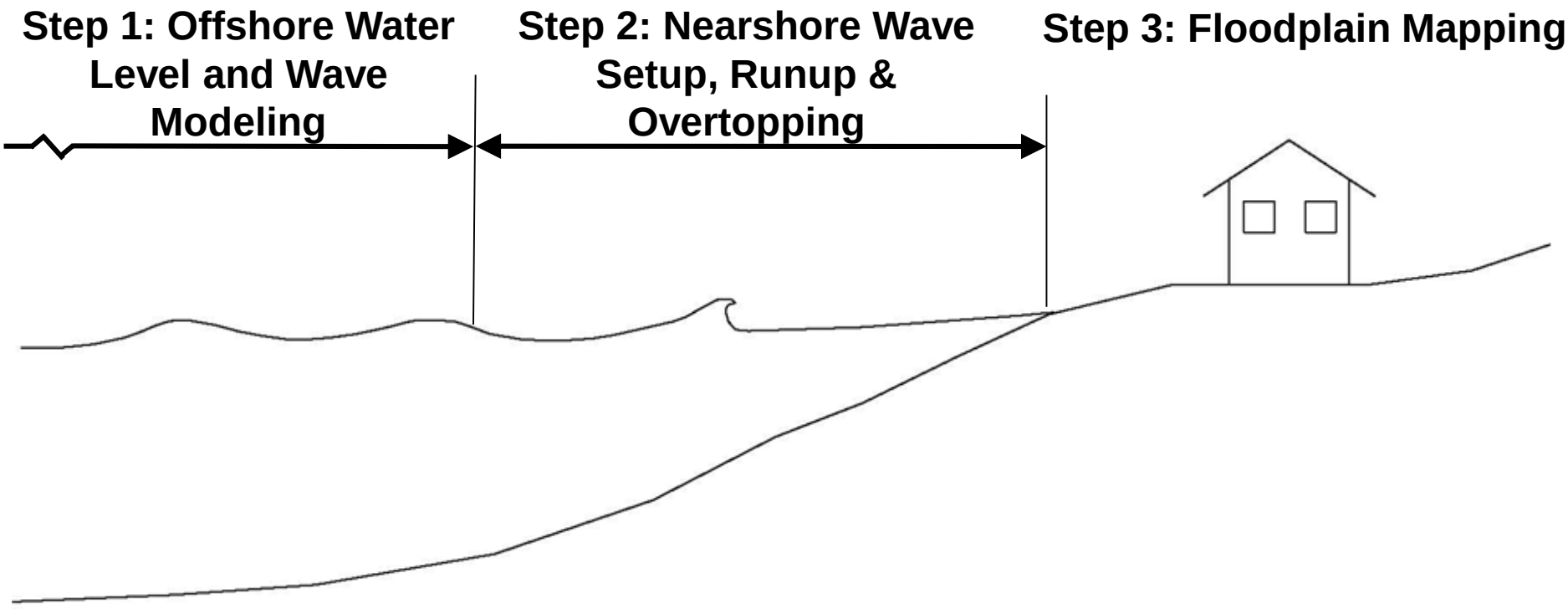
REGION/RSC INITIATIVES ✚

Coastal Analysis Modeling Comparison

Guidelines for Coastal Flood Hazard Mapping and Analysis for Pacific Coast of the United States January 2005

	Old Approach	New Approach
Analysis Method	USACE Shore Protection Manual	FEMA Pacific Coast Guidelines (2005)
Wind data	Short Periods of Observations	Regional Hindcast Models
Water Level Model	Seattle Tide Gage	ADCIRC Model Puget Sound
Wave Model	1-Dimensional	2-Dimensional (SWAN)
Topography	**USGS Contour Maps**	**2010-15 LiDAR data**
Study Scope	**Detail Few Specific Areas**	**Entire Populated US Coastline**

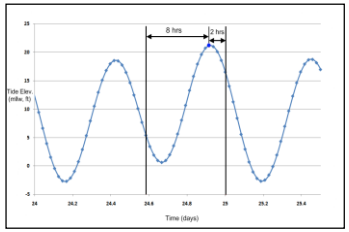
Coastal Analysis Overview



Step 1: Salish Sea & Puget Sound Water Level Modeling

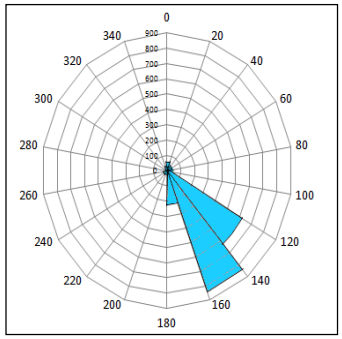
Baseline

Tides

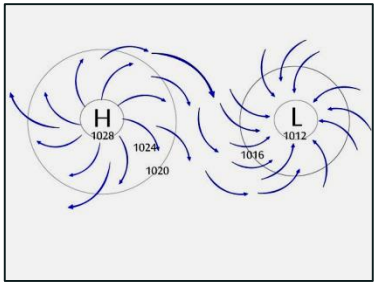


Meteorological Forcing

Wind

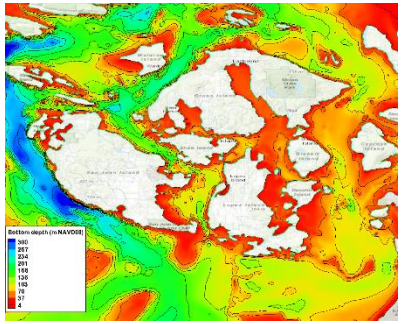


Pressure

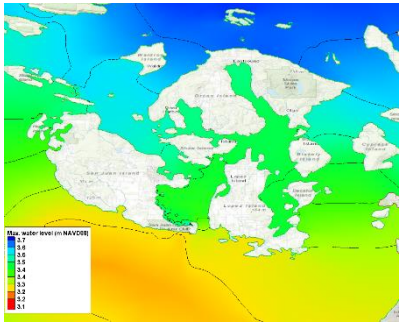


Physical Setting

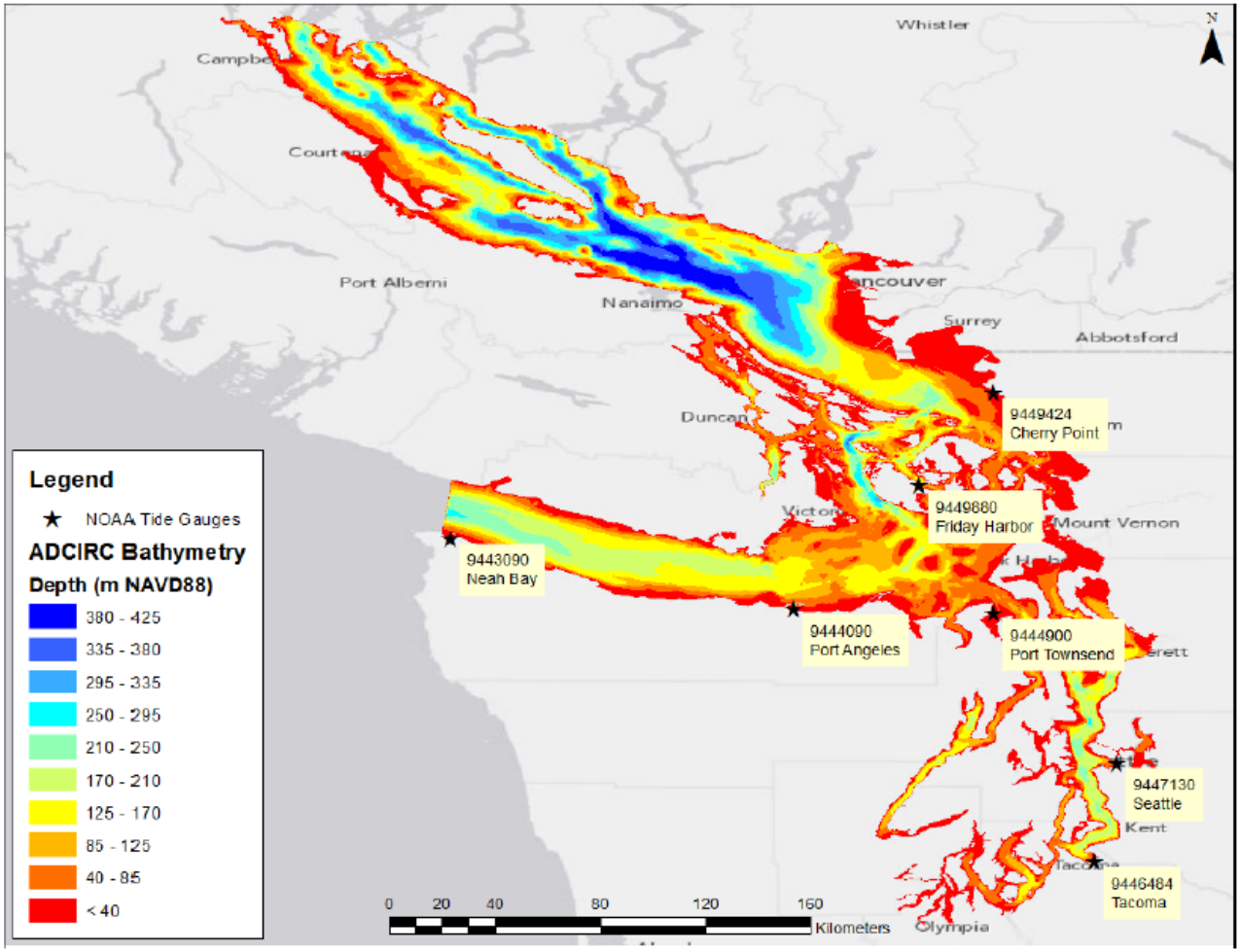
Bathymetry



Still Water Elevations

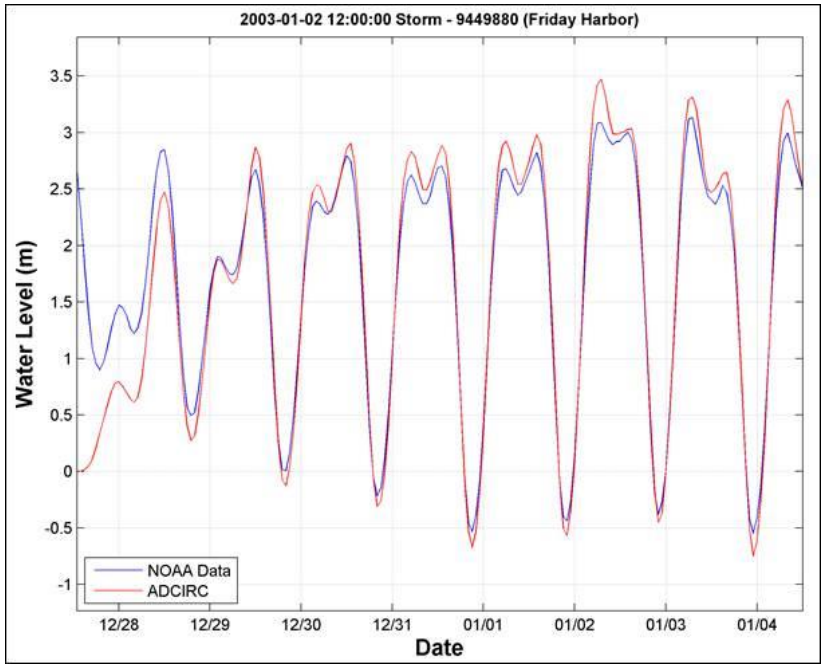


Step 1: Salish Sea & Puget Sound Water Level Modeling (ADCIRC)



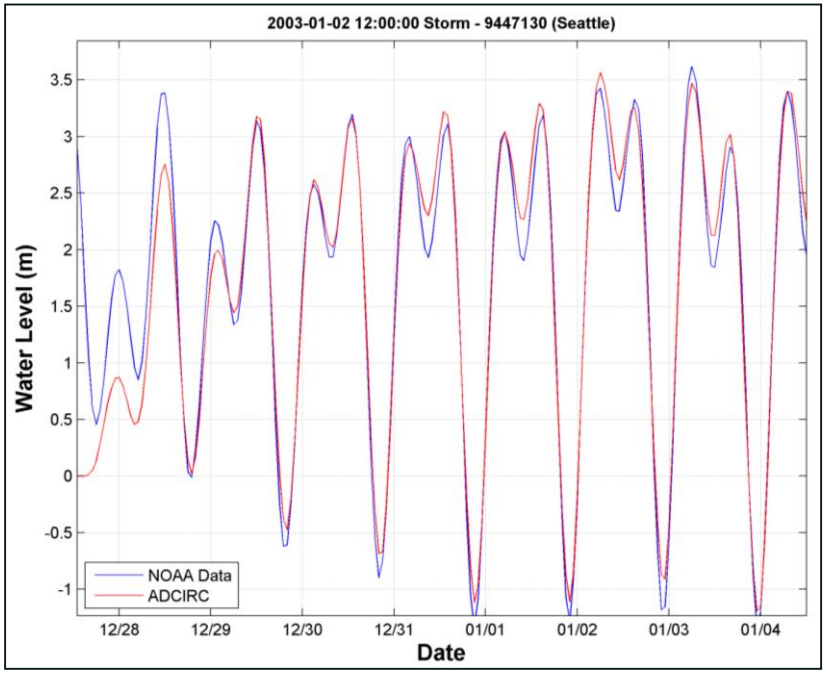
- **ADvanced CIRCulation Model (ADCIRC)**
- **Model Inputs:**
  - Bathymetry
  - Wind forcing
  - Pressure
  - Tidal forcing
- **Model Outputs:**
  - Water elevation for 150 peak water level events

Step 1: Salish Sea & Puget Sound Water Level Modeling (ADCIRC)

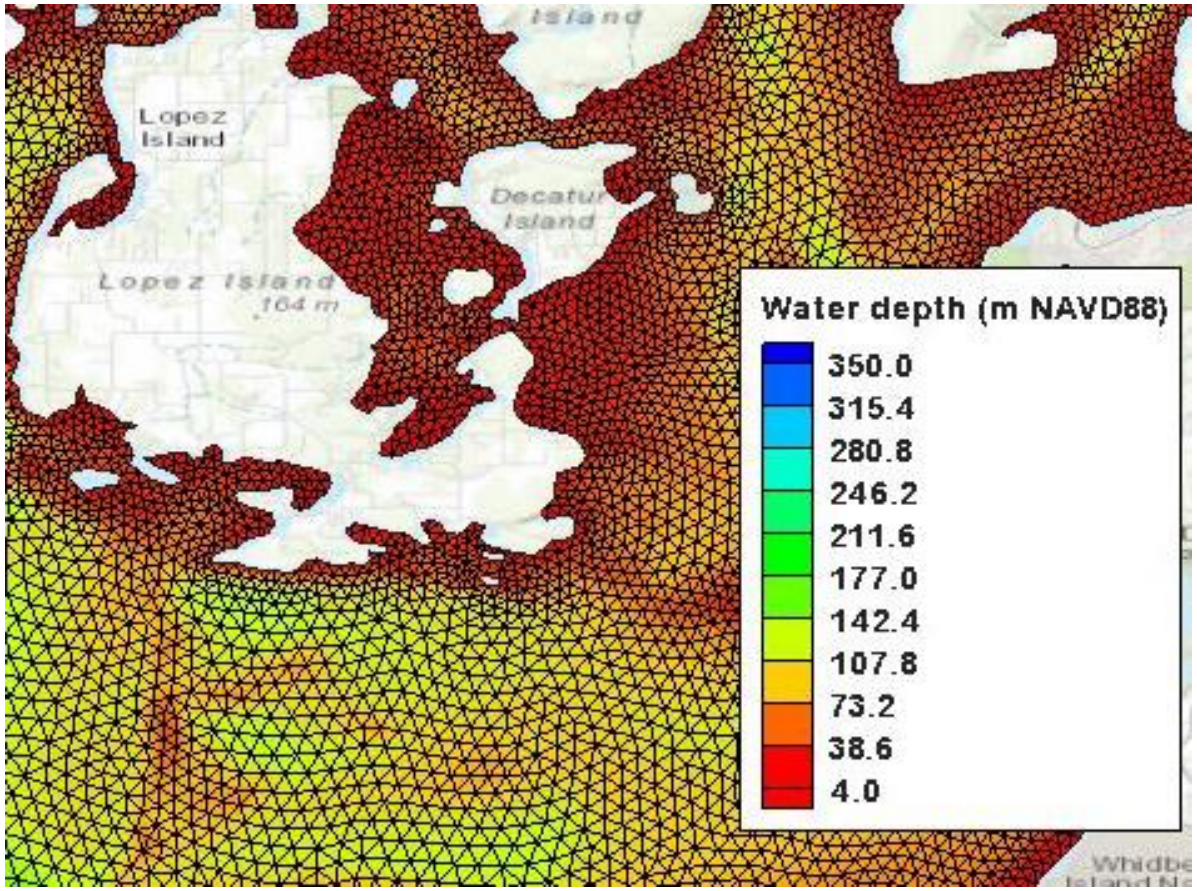


Example Calibrated ADCIRC Water Level Friday Harbor

Example Calibrated ADCIRC Water Level Seattle



Step 1 - Wave Modeling

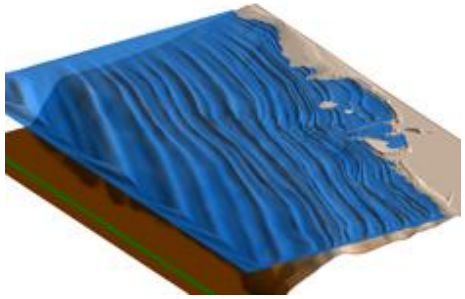


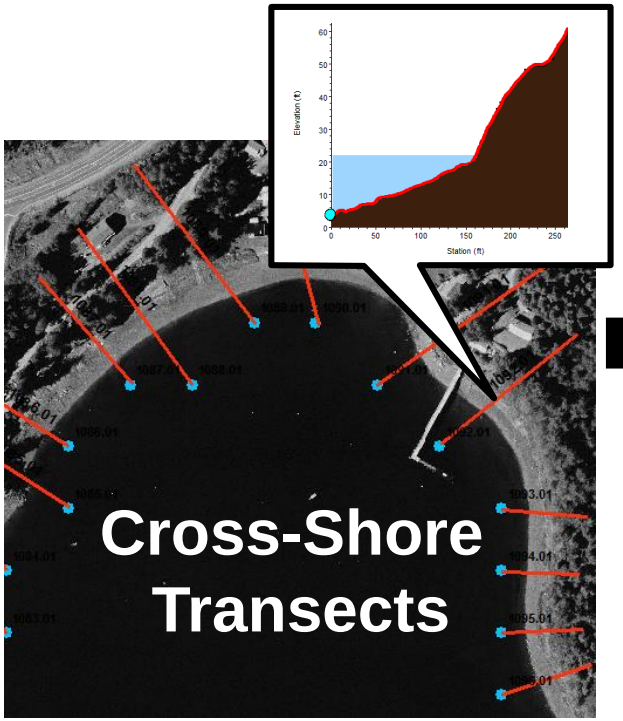
- SWAN model grid
- Variable grid resolution for nearshore/offshore regions
- 50-year hindcast wind fields
- 150 modeled storm events

Step 2: Wave Setup, Runup & Overtopping (Transect Analysis)

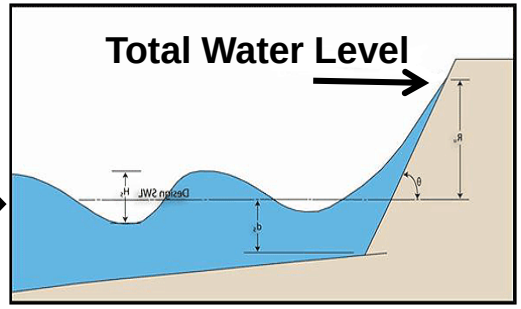
Transect Analysis

Water Level & Wave Data



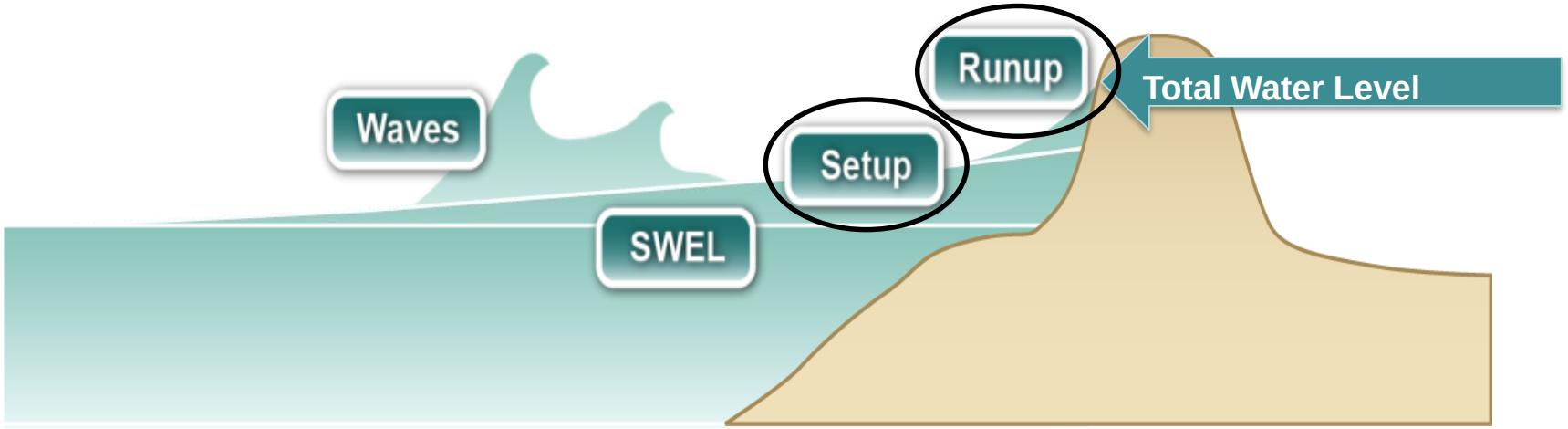


Total Water Level



Total Water Level
1. Water Level (Surge)
2. Waves
3. Setup, Runup and/or Overtopping

Step 2: Wave Setup and Runup (Transect Analysis)



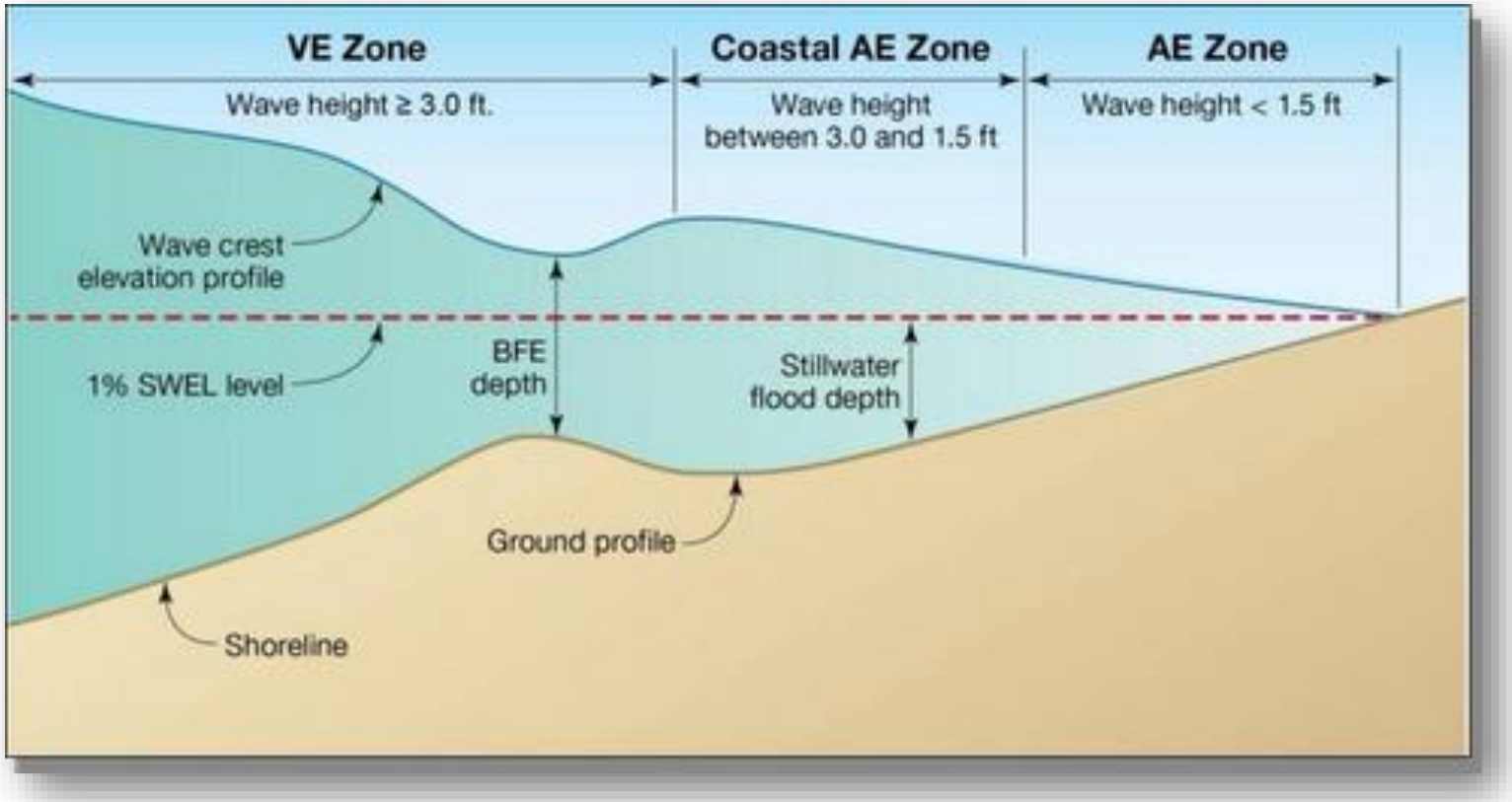
Wave Height
Wave Period
SWEL
Profile Slope

→

Wave Setup

Wave Runup

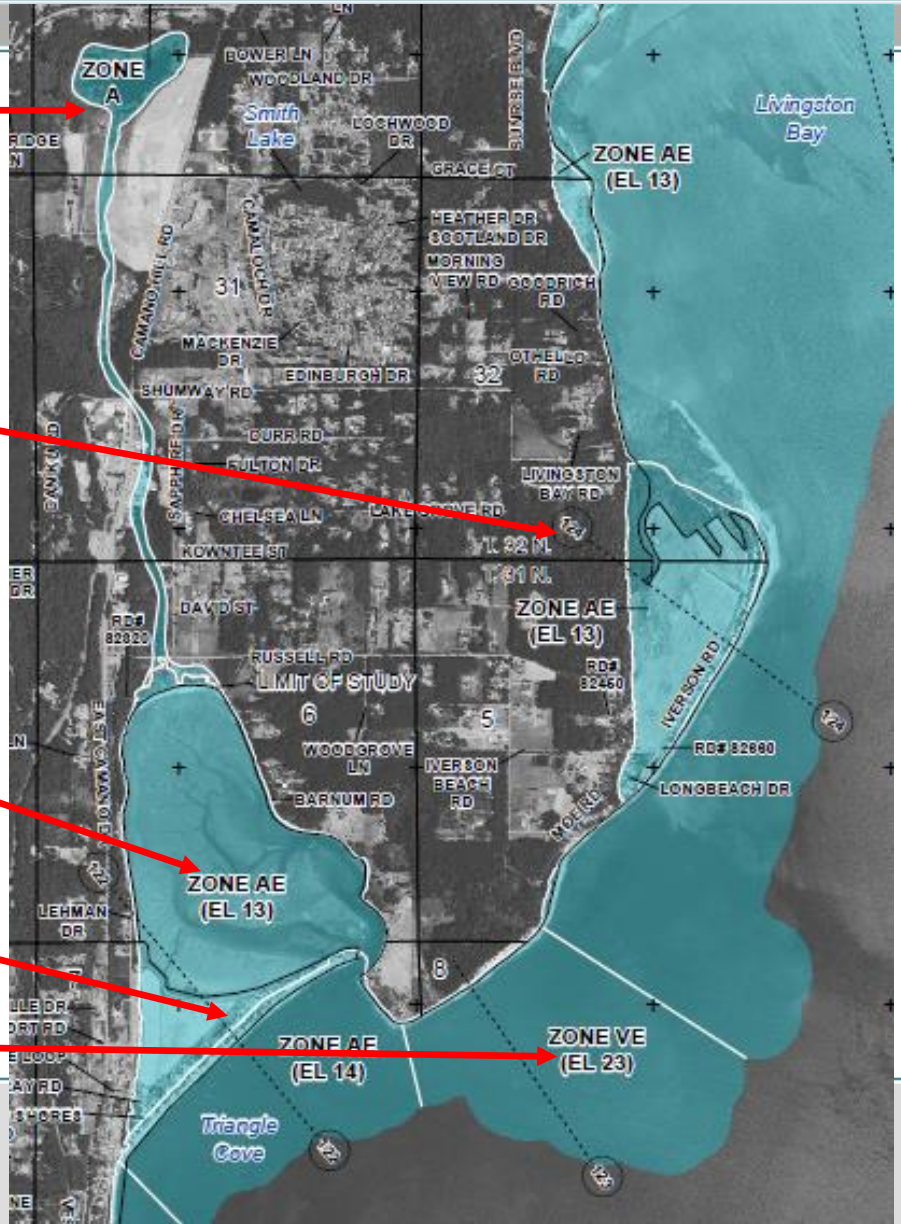
Step 3: Floodplain Mapping



Digital Flood Insurance Rate Maps

Flood Insurance Rate Map Labels

- River/Lake A Zone
- Transect
- AE Zone
- Zone Break
- VE Zone



Questions???

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Regional Engineer
FEMA Region X
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425-487-4684

WCRP Update: Extreme Coastal Water Level Assessment

Ian Miller, PhD
Coastal Hazards Specialist
Washington Sea Grant
immiller@uw.edu

With

Guillaume Mauger
Harriet Morgan
Eric Grossman
Nathan Van Arendonck
Zhaoqing Yang

THE WASHINGTON COASTAL RESILIENCE PROJECT

Sea Grant Washington

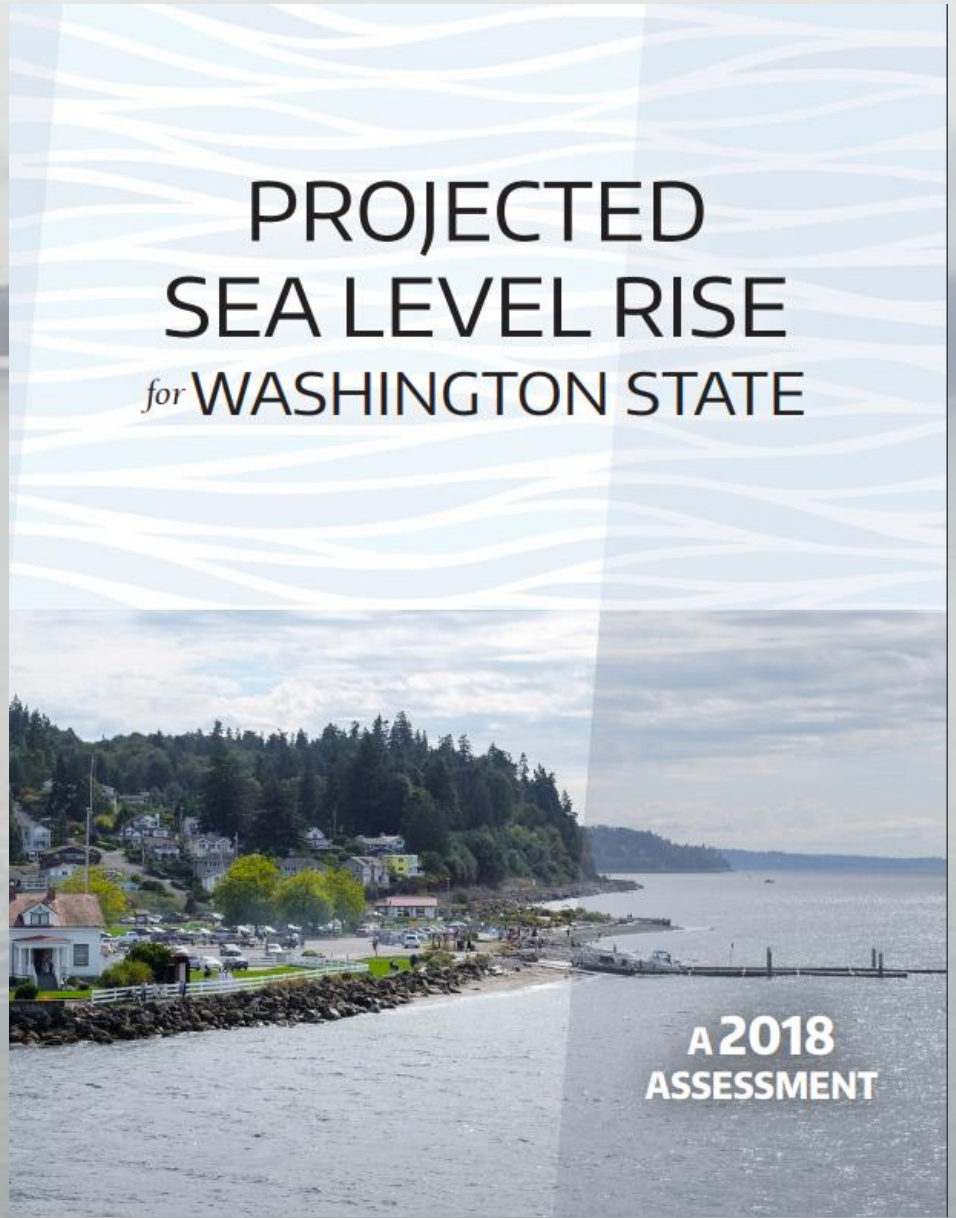
WESTERN WASHINGTON UNIVERSITY

USGS science for a changing world

CLIMATE IMPACTS GROUP

COLLEGE OF ENGINEERING
UNIVERSITY of WASHINGTON

WCRP Update: Extreme Coastal Water Level Assessment



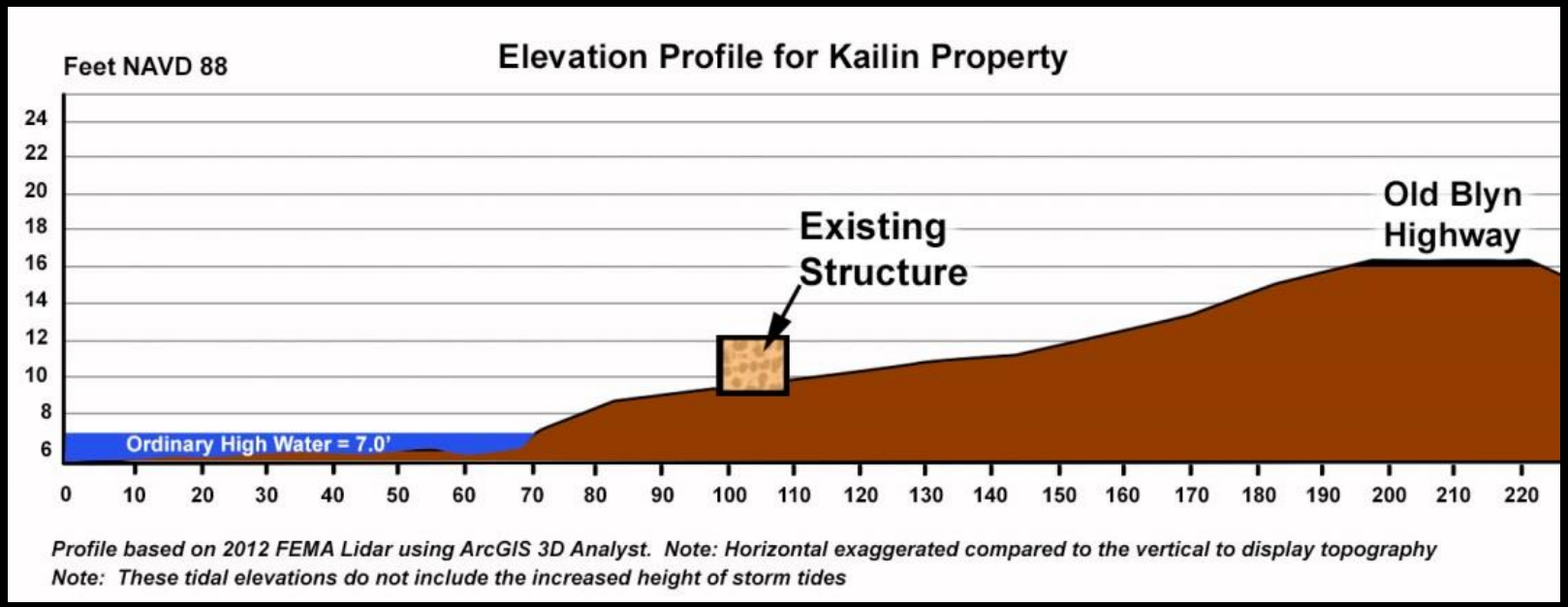
Updated sea level projections published last summer

Available at http://www.wacoastalnetwork.com/ along with supplementary data and materials

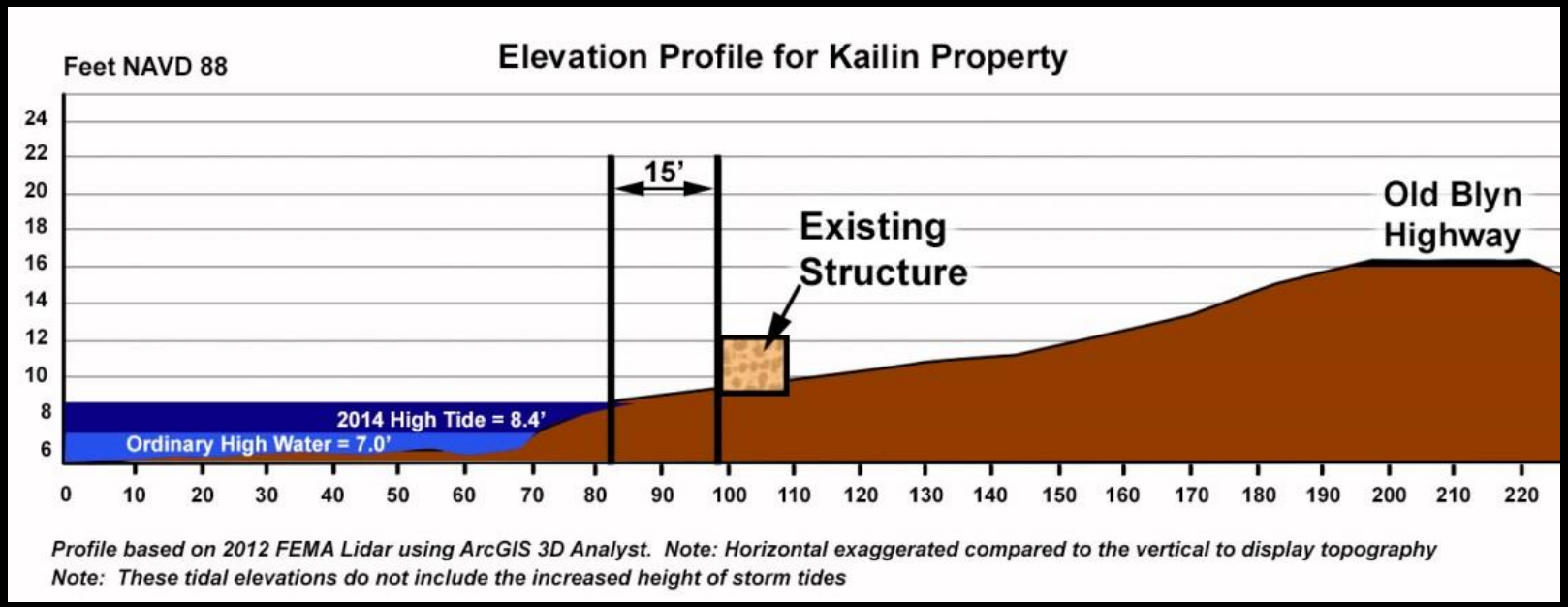
How frequent are “extreme” events at my location?
How high can they get? How high WILL they get?

Incorporating extremes into SLR planning: A case study courtesy of the JSKT

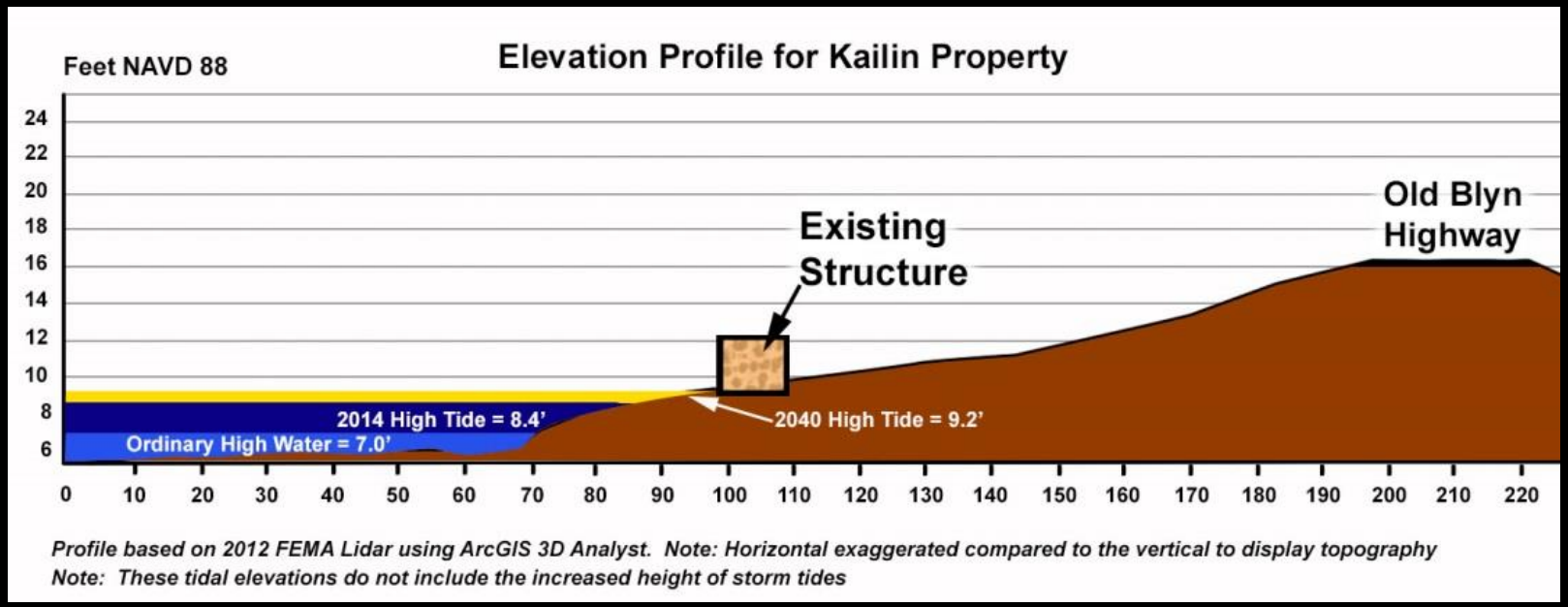
Kailin Property, Blyn WA



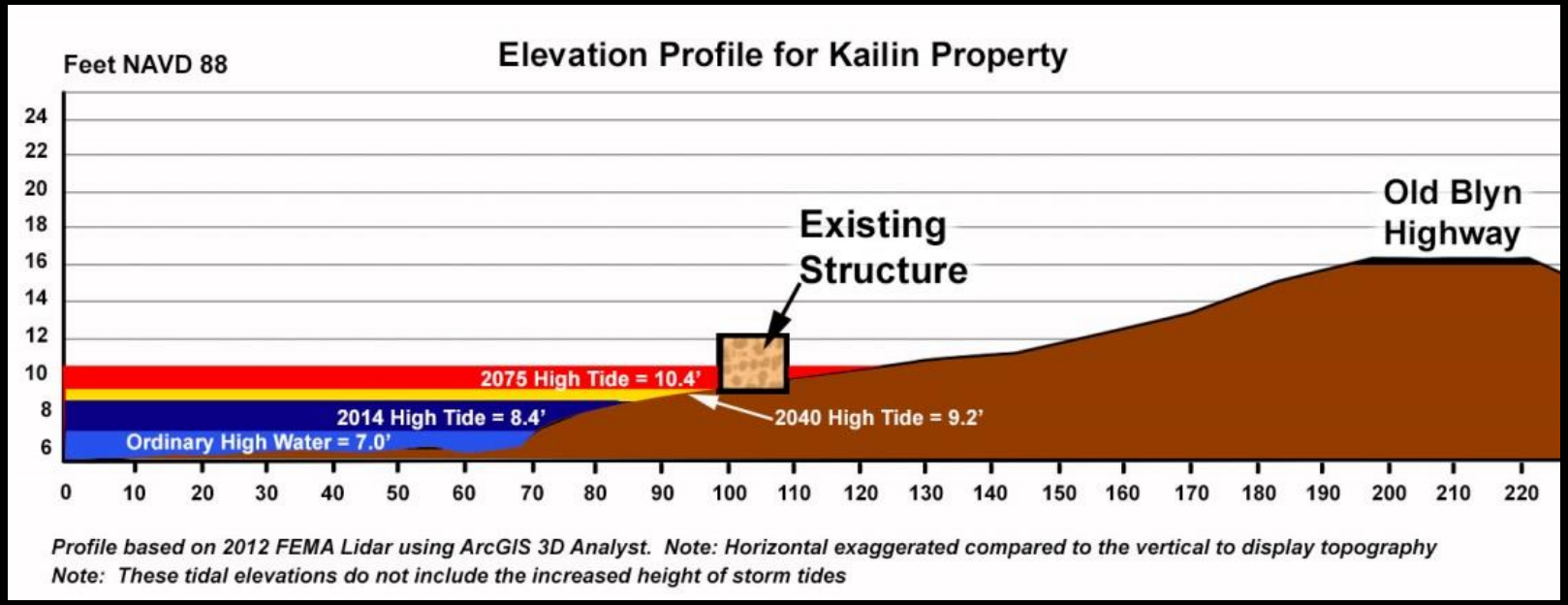
Here is some coastal infrastructure we want to try to make good decisions about. Will it possibly be at risk during an extreme event in the future?



Planning Scenario: Highest Water Level in 2014

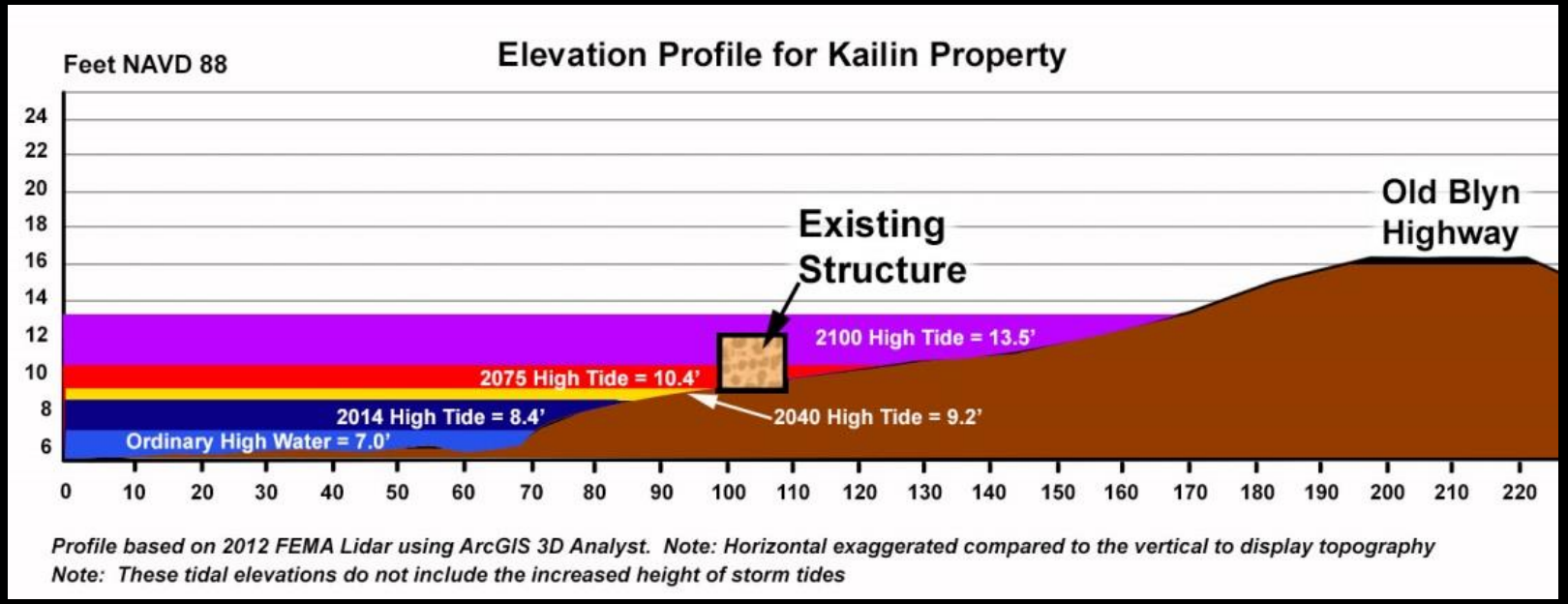


Planning Scenario: RCP 8.5, 1% chance of exceedance (high magnitude, low probability)



Profile based on 2012 FEMA Lidar using ArcGIS 3D Analyst. Note: Horizontal exaggerated compared to the vertical to display topography

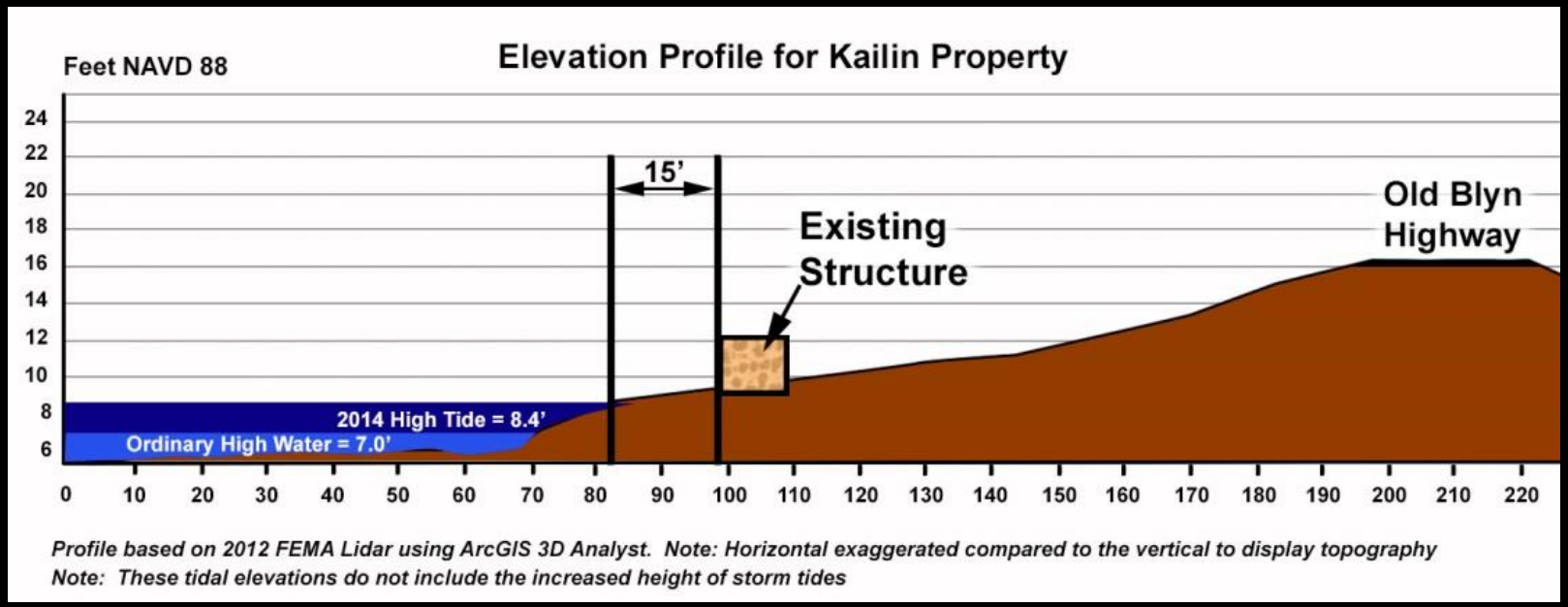
Note: These tidal elevations do not include the increased height of storm tides



Profile based on 2012 FEMA Lidar using ArcGIS 3D Analyst. Note: Horizontal exaggerated compared to the vertical to display topography

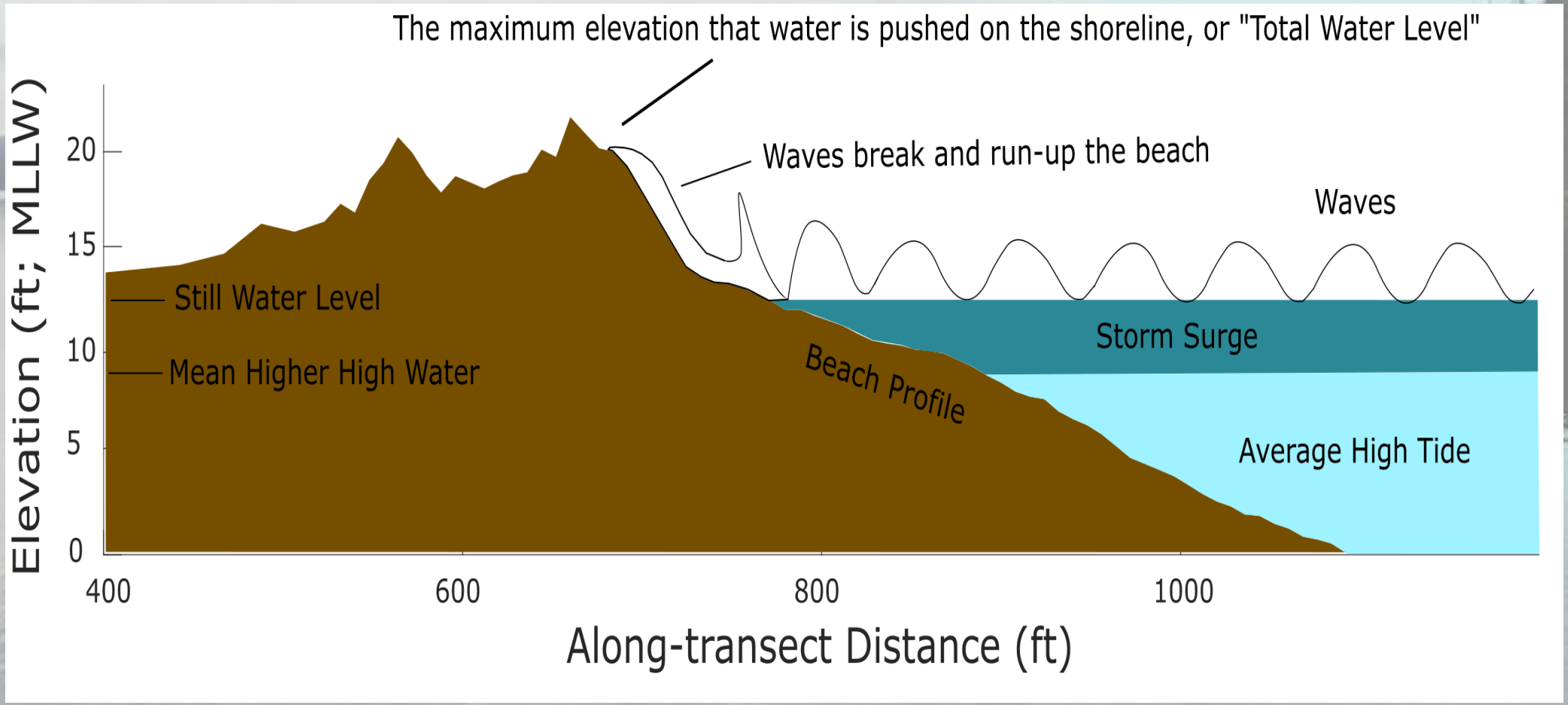
Note: These tidal elevations do not include the increased height of storm tides

Lets go back to here…this is the step we are trying to inform with our current work

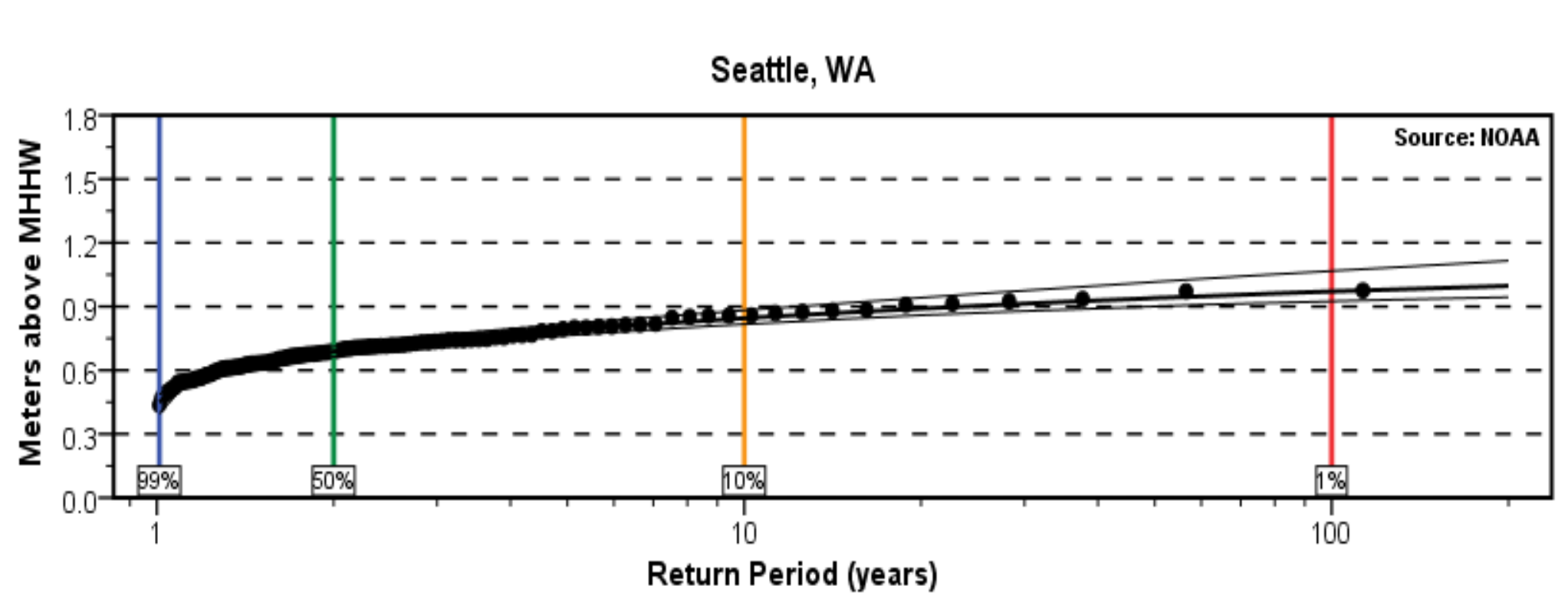


Planning Scenario: Highest Water Level in 2014

First Key Element: "Still" vs. "Total" Water Level

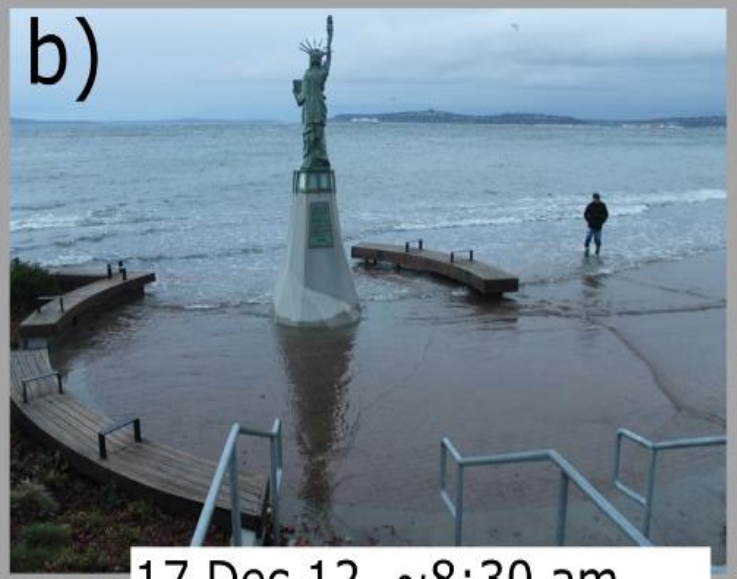


Second Key Element: A Return Frequency Framework (where possible)



Third Element: Tie everything to current MHHW

31 May 18, ~8:00 pm
SWL = 0.0 ft MHHW
credit: Melissa Poe



17 Dec 12, ~8:30 am
SWL = 3.1 ft MHHW
credit: West Seattle Blog

29 Nov 14, ~10:30 am
SWL = 1.8 ft MHHW
credit: Melissa Poe

The key result: SWL

Sea Level Scenario (feet)	Return Frequency:	Puget Sound/Strait of Juan de Fuca					Coast				
		2-yr	5-yr	20-yr	50-yr	100-yr	2-yr	5-yr	20-yr	50-yr	100-yr
	0	2.2	2.6	2.9	3.1	3.2	2.9	3.3	3.7	3.9	4.0
	0.5	2.7	3.1	3.4	3.6	3.7	3.4	3.8	4.1	4.4	4.5
	1.0	3.2	3.6	3.9	4.1	4.2	3.9	4.3	4.7	4.9	5.0
	1.5	3.7	4.1	4.4	4.6	4.7	4.4	4.8	5.2	5.4	5.5
	2.0	4.2	4.6	4.9	5.1	5.2	4.9	5.3	5.7	5.9	6.0
	2.5	4.7	5.1	5.4	5.6	5.7	5.4	5.8	6.2	6.4	6.5
	3.0	5.2	5.6	5.9	6.1	6.2	5.9	6.3	6.7	6.9	7.0
	4.0	6.2	6.6	6.9	7.1	7.2	6.9	7.3	7.7	7.9	8.0
	5.0	7.2	7.6	7.9	8.1	8.2	7.9	8.3	8.7	8.9	9.0
	6.0	8.2	8.6	8.9	9.1	9.2	8.9	9.3	9.7	9.9	10.0
	7.0	9.2	9.6	9.9	10.1	10.2	9.9	10.3	10.7	10.9	11.0
	8.0	10.2	10.6	10.9	11.1	11.2	10.9	11.3	11.7	11.9	12.0
	9.0	11.2	11.6	11.9	12.1	12.2	11.9	12.3	12.7	12.9	13.0
	10.0	12.2	12.6	12.9	13.1	13.2	12.9	13.3	13.7	13.9	14.0

A Puget Sound “Extreme Event”

Use it to assess the change in frequency of an existing event

Sea-level scenario	Still Water (i.e. tides + surge) Return Frequency in feet relative to MHHW				
	1-yr	5-yr	20-yr	50-yr	100-yr
0	*0.8*	*2.2*	*2.6*	*2.9*	*3.2*
0.5	*1.3*	*2.7*	*3.1*	*3.4*	*3.7*
1	*1.8*	*3.2*	*3.6*	*3.9*	*4.2*
1.5	*2.3*	*3.7*	*4.1*	*4.4*	*4.7*
2	*2.8*	*4.2*	*4.6*	*4.9*	*5.2*
2.5	*3.3*	*4.7*	*5.1*	*5.4*	*5.7*
3	*3.8*	*5.2*	*5.6*	*5.9*	*6.2*
4	*4.8*	*6.2*	*6.6*	*6.9*	*7.2*
5	*5.8*	*7.2*	*7.6*	*7.9*	*8.2*
6	*6.8*	*8.2*	*8.6*	*8.9*	*9.2*
7	*7.8*	*9.2*	*9.6*	*9.9*	*10.2*
8	*8.8*	*10.2*	*10.6*	*10.9*	*11.2*
9	*9.8*	*11.2*	*11.6*	*11.9*	*12.2*
10	*10.8*	*12.2*	*12.6*	*12.9*	*13.2*

Every Day at High Tide

Key Result: TWL on the coast

		Toke Point/South Coast					Makah Bay/North Coast				
	- Return Frequency:	2-yr	5-yr	20-yr	50-yr	100-yr	2-yr	5-yr	20-yr	50-yr	100-yr
Sea Level Scenario (feet)	0	10.9	11.5	12.9	13.6	14.2	9.8	11.6	12.0	12.8	13.2
	0.5	11.4	12	13.4	14.1	14.7	10.3	12.1	12.5	13.3	13.7
	1.0	11.9	12.5	13.9	14.6	15.2	10.8	12.6	13	13.8	14.2
	1.5	12.4	13	14.4	15.1	15.7	11.3	13.1	13.5	14.3	14.7
	2.0	12.9	13.5	14.9	15.6	16.2	11.8	13.6	14	14.8	15.2
	2.5	13.4	14	15.4	16.1	16.7	12.3	14.1	14.5	15.3	15.7
	3.0	13.9	14.5	15.9	16.6	17.2	12.8	14.6	15	15.8	16.2
	4.0	14.9	15.5	16.9	17.6	18.2	13.8	15.6	16	16.8	17.2
	5.0	15.9	16.5	17.9	18.6	19.2	14.8	16.6	17	17.8	18.2
	6.0	16.9	17.5	18.9	19.6	20.2	15.8	17.6	18	18.8	19.2
	7.0	17.9	18.5	19.9	20.6	21.2	16.8	18.6	19	19.8	20.2
	8.0	18.9	19.5	20.9	21.6	22.2	17.8	19.6	20	20.8	21.2
	9.0	19.9	20.5	21.9	22.6	23.2	18.8	20.6	21	21.8	22.2
	10.0	20.9	21.5	22.9	23.6	24.2	19.8	21.6	22	22.8	23.2

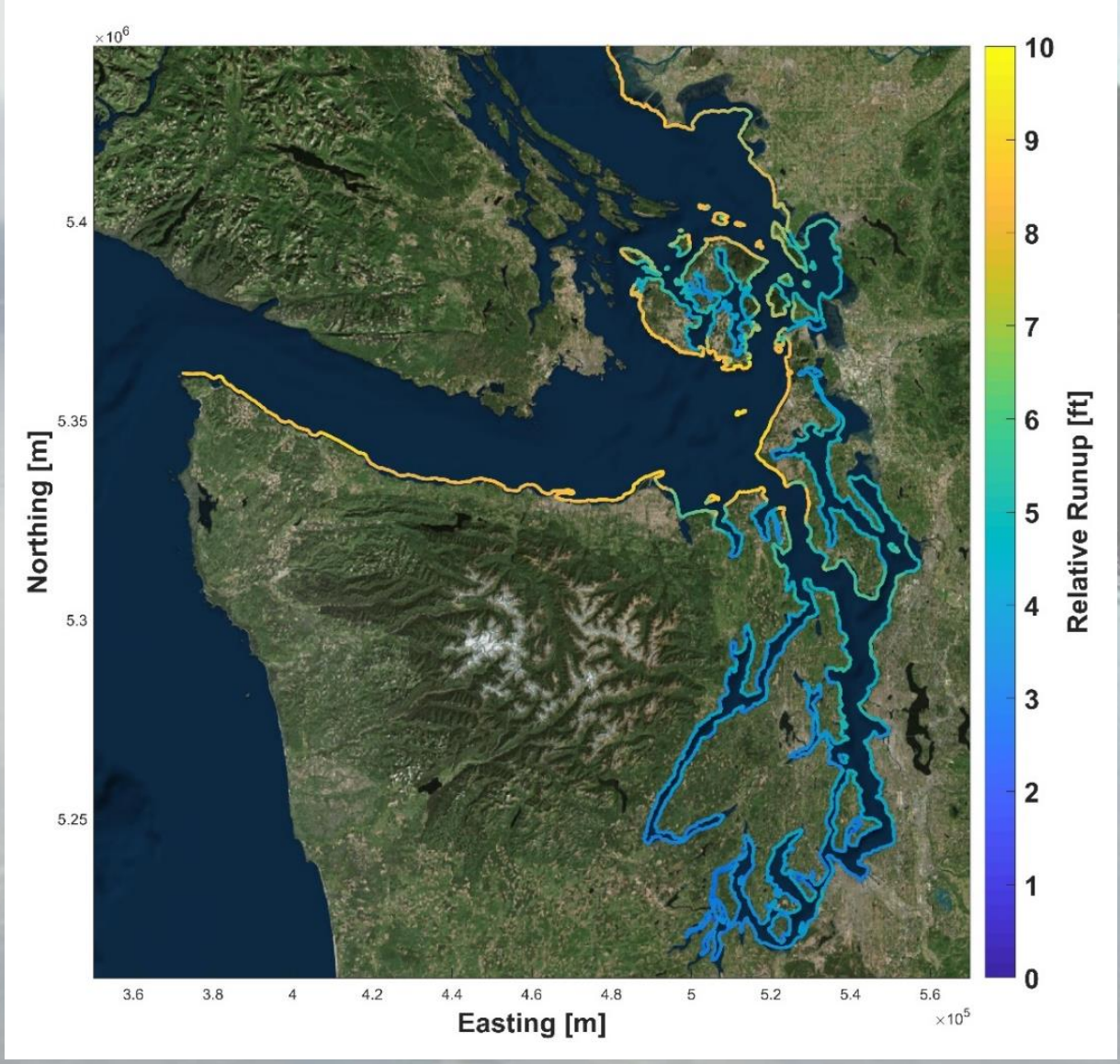
What if I want a TWL return frequency information on Puget Sound?

Answer 1: Maybe you don't really need it

Answer 2: Use something like a BFE

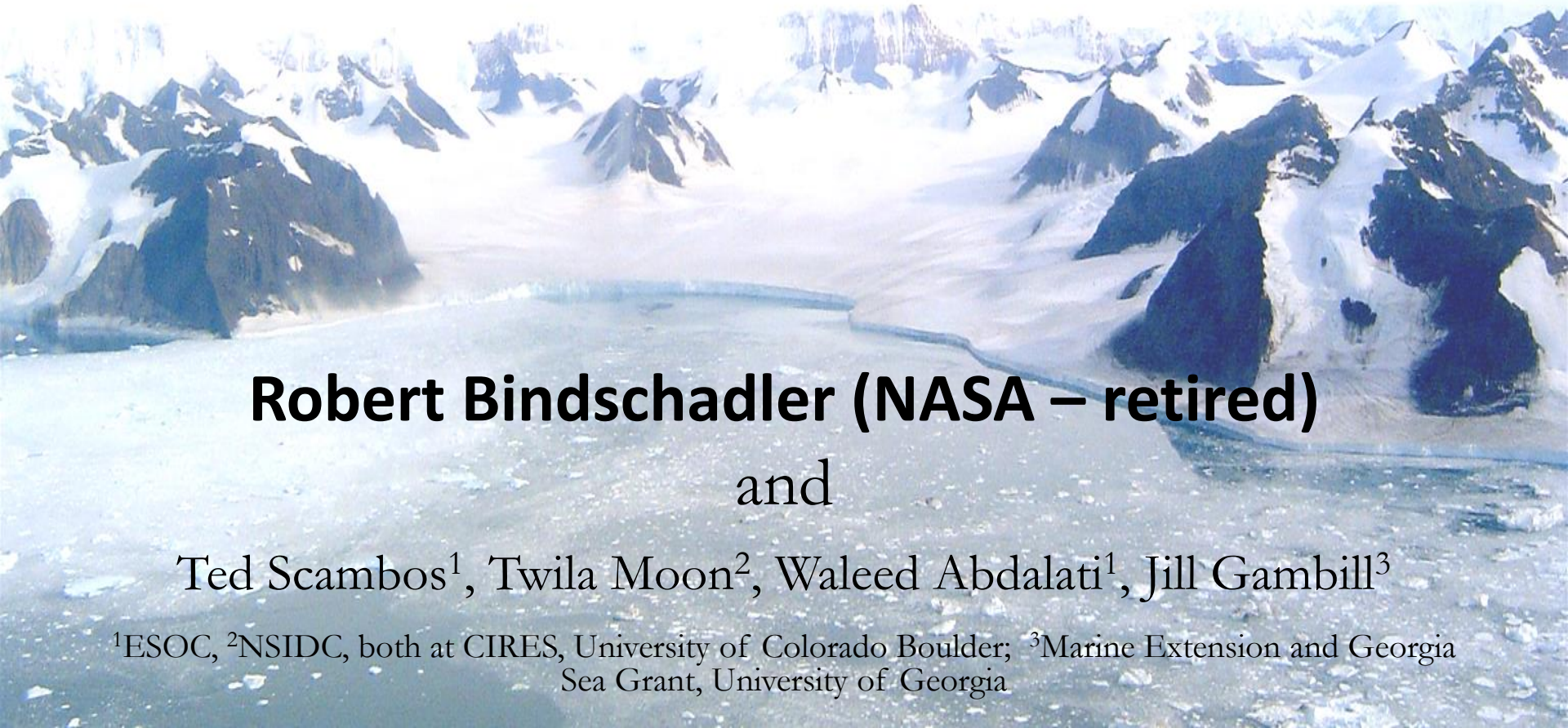
Answer 3: Maybe you can use an event of record for your location?

Answer 4: New wave modelling provides some sense for the real extremes…but its not perfect



Thank you!

What's making future sea level so hard to predict accurately?



Robert Bindschadler (NASA – retired)

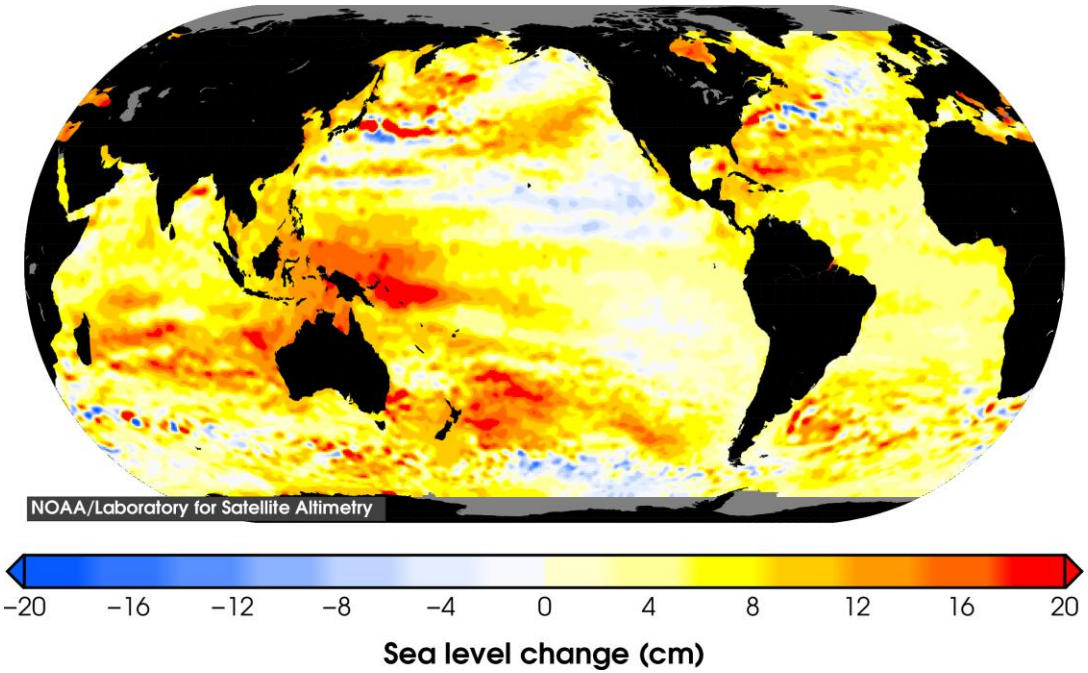
and

Ted Scambos[1], Twila Moon[2], Waleed Abdalati[1], Jill Gambill[3]

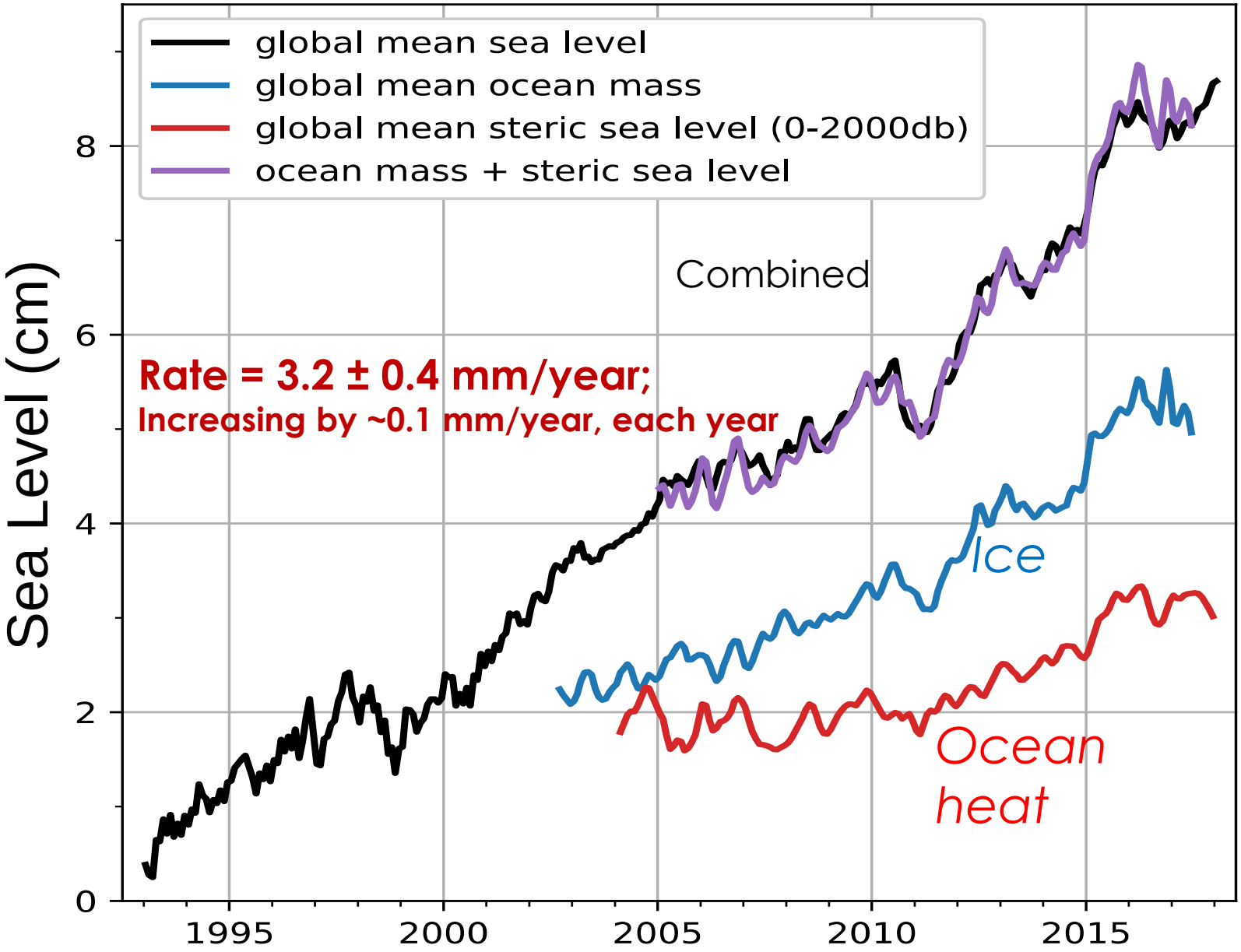
[1]ESOC, [2]NSIDC, both at CIRES, University of Colorado Boulder; [3]Marine Extension and Georgia Sea Grant, University of Georgia

Multiple Global & Regional Effects

- Glaciological
  - Ice Mass Loss
- Geodetic
  - Gravitational
  - Tectonic
  - Subsidence
- Oceanic
  - Temperature
  - Currents
- Meteorological
  - Wind-driven waves

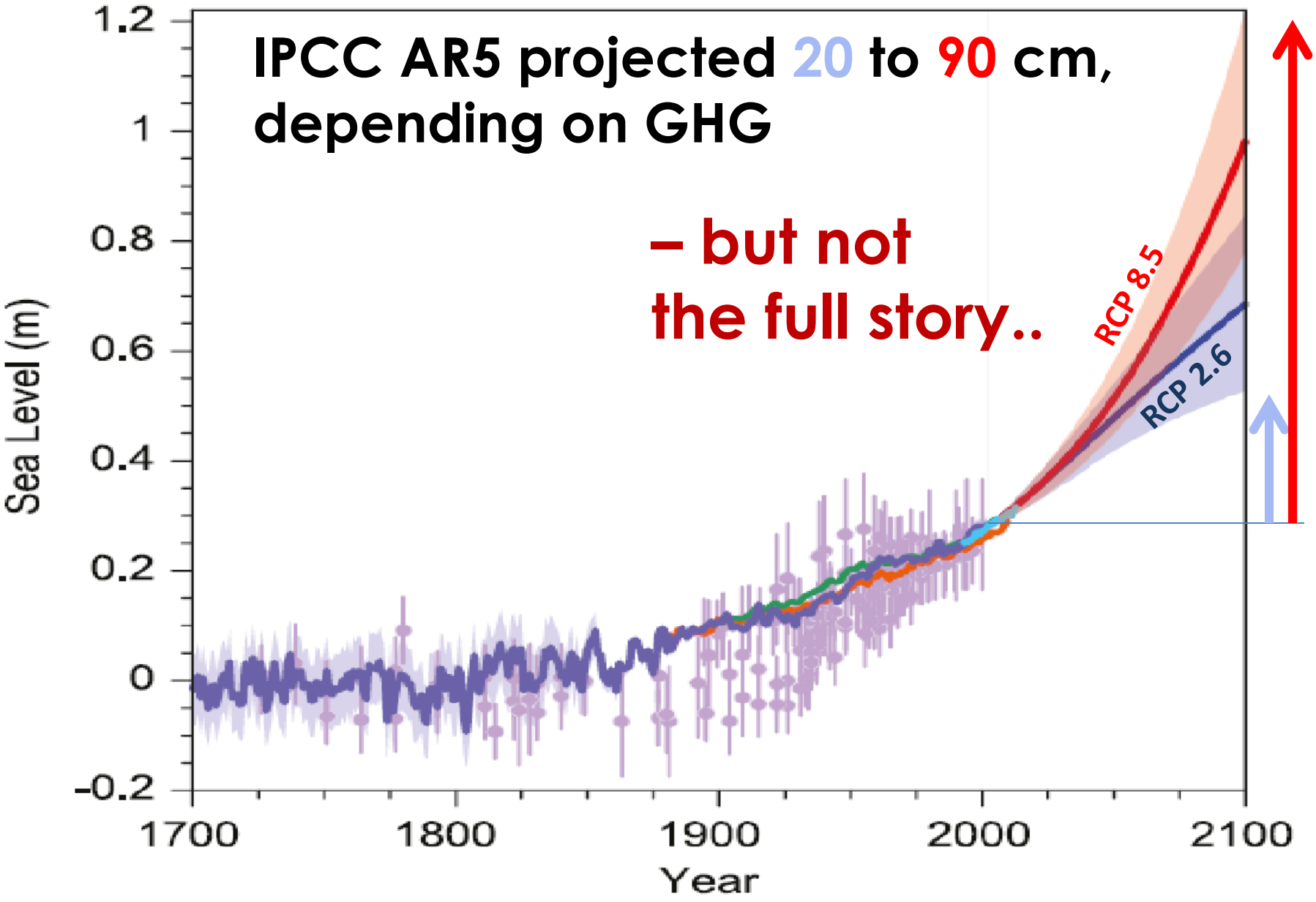


Global Sea Level Trend, 1993-2018



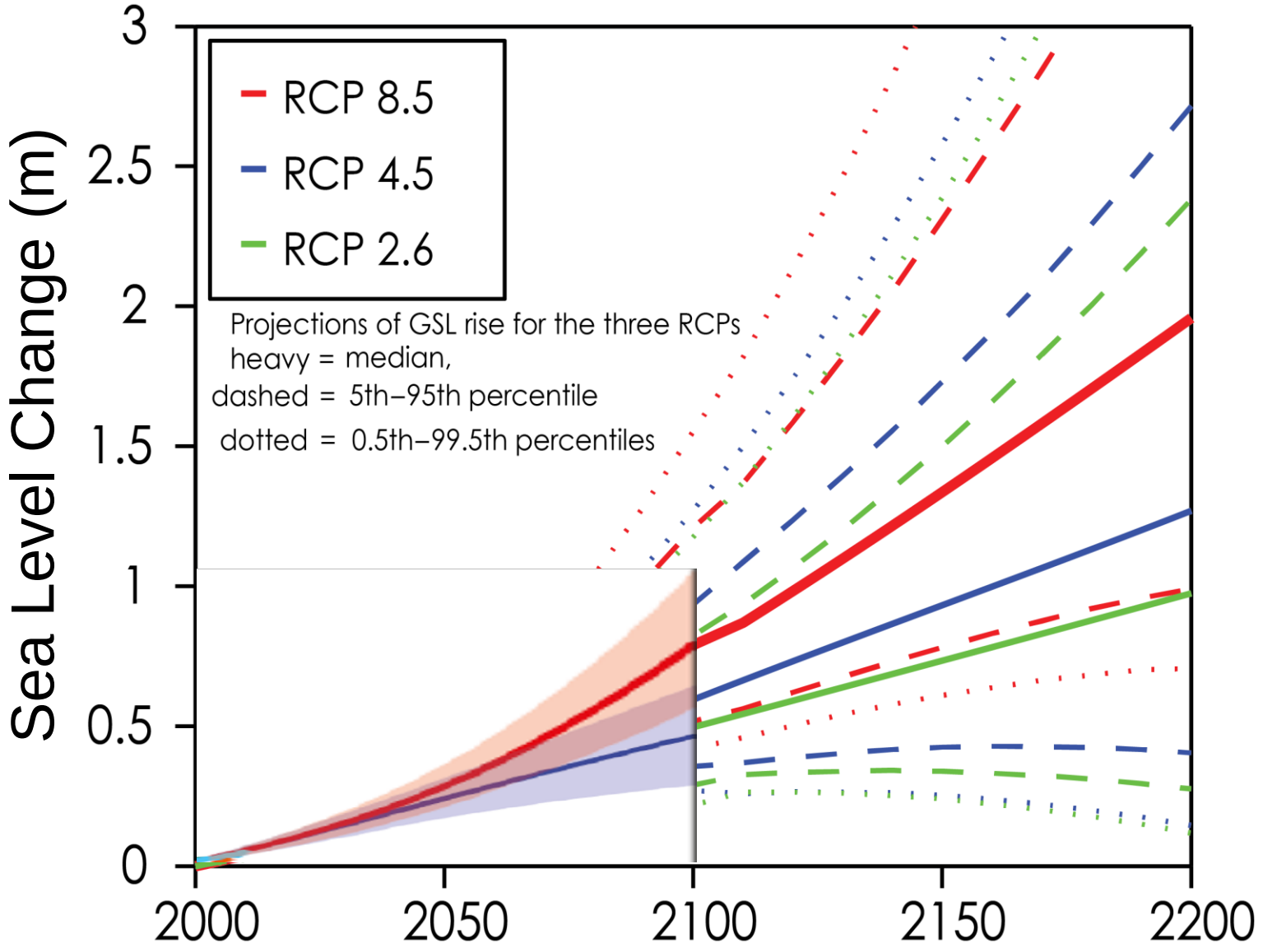
Leuliette, 2018; NOAA Laboratory for Satellite Altimetry

Observed and Projected Change in Global Mean Sea Level



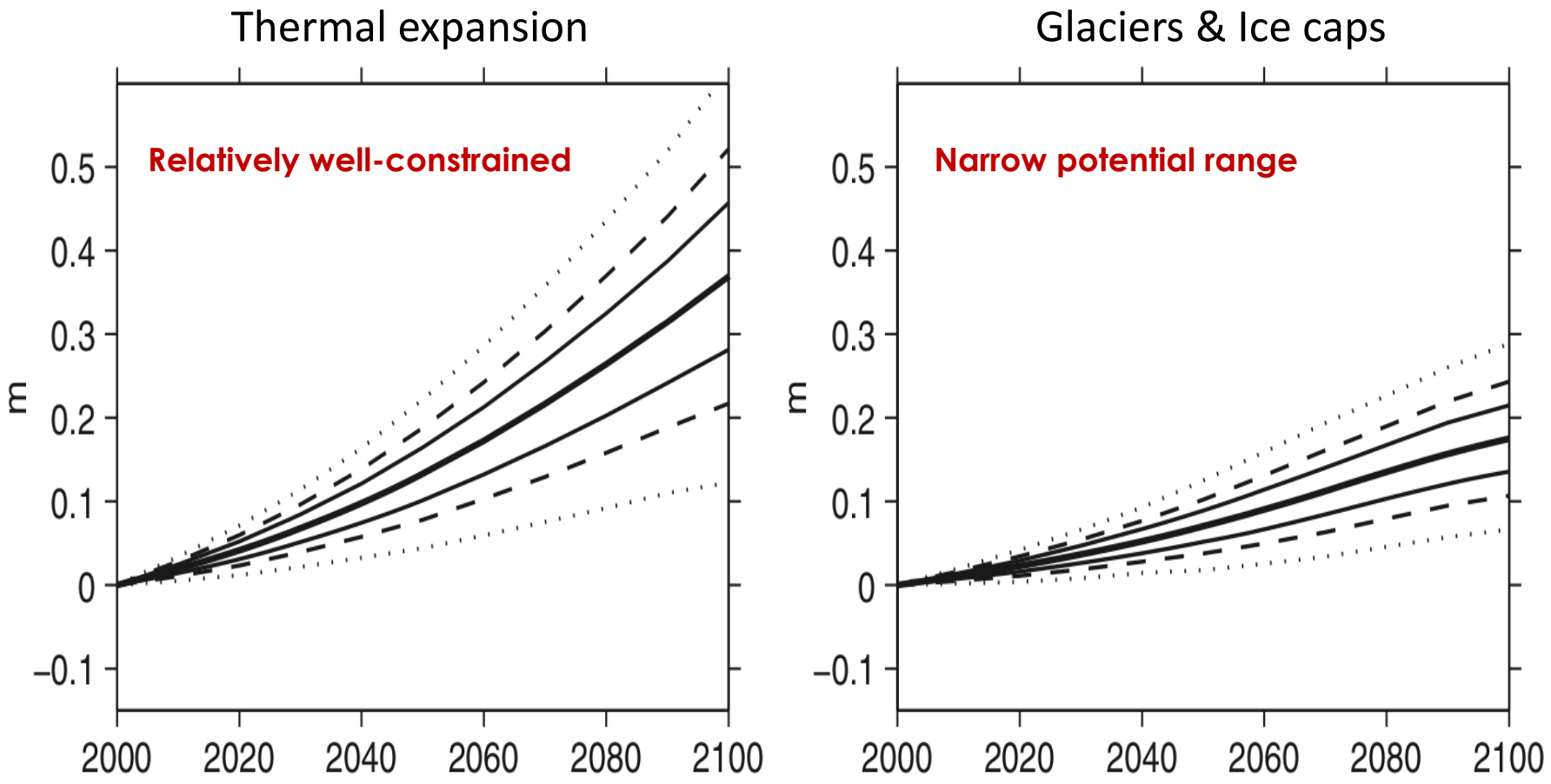
IPCC AR5;

Including potential aspects of **rapid ice sheet & glacier decline** broadens projected range.



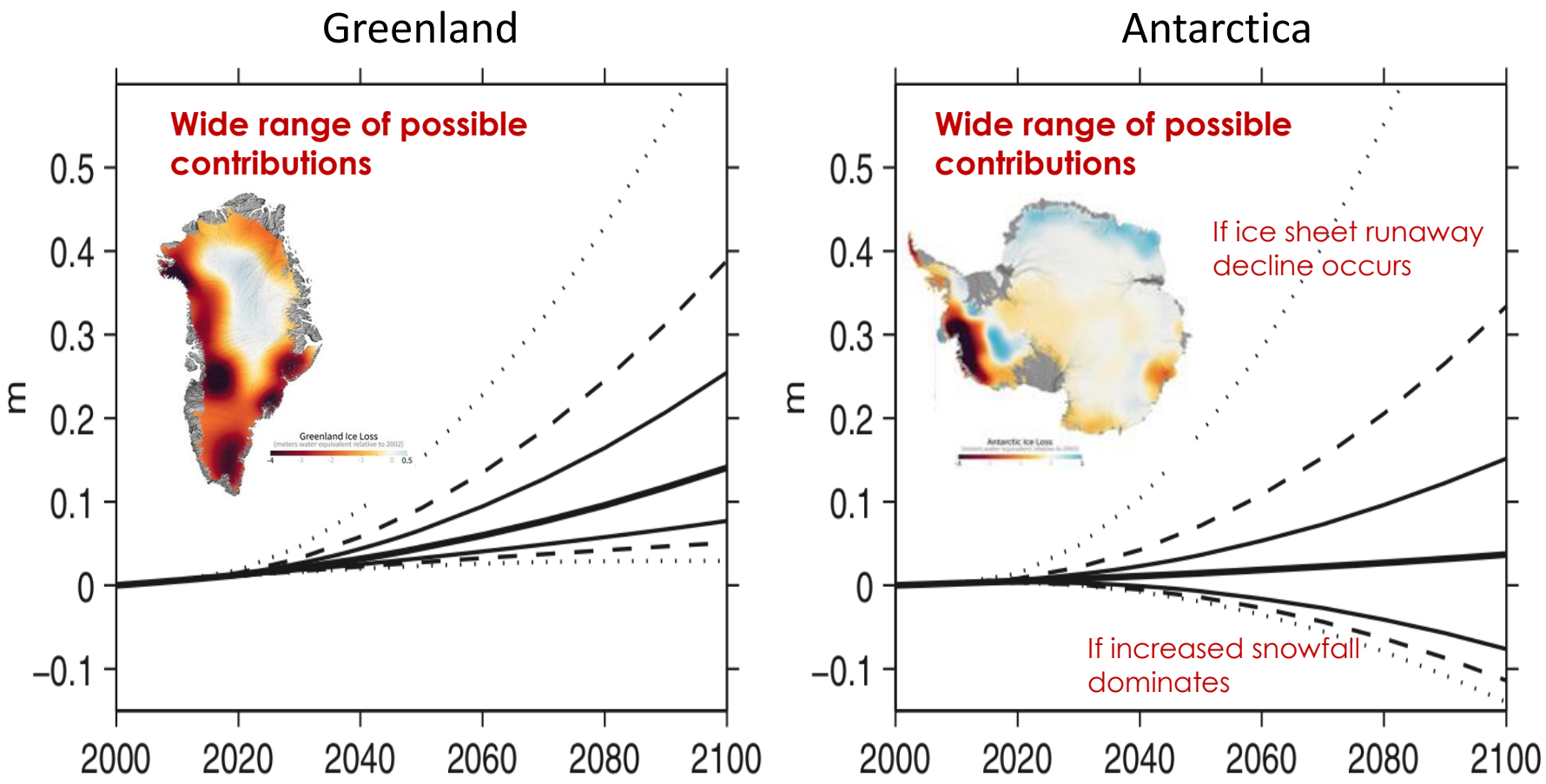
Kopp et al., 2014

Forecasts for ocean heat and glacier loss



Kopp et al., *Earth's Future, 2014*

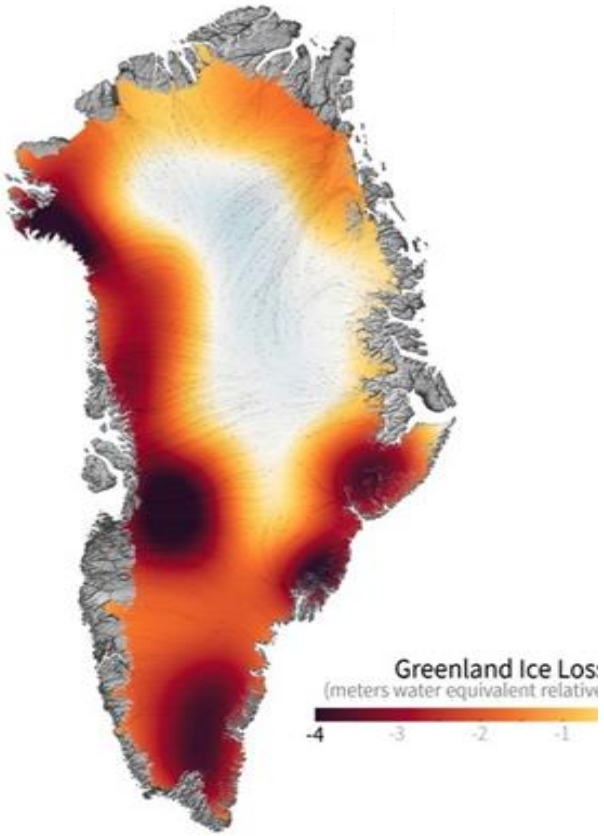
Large potential future SLR from land ice loss

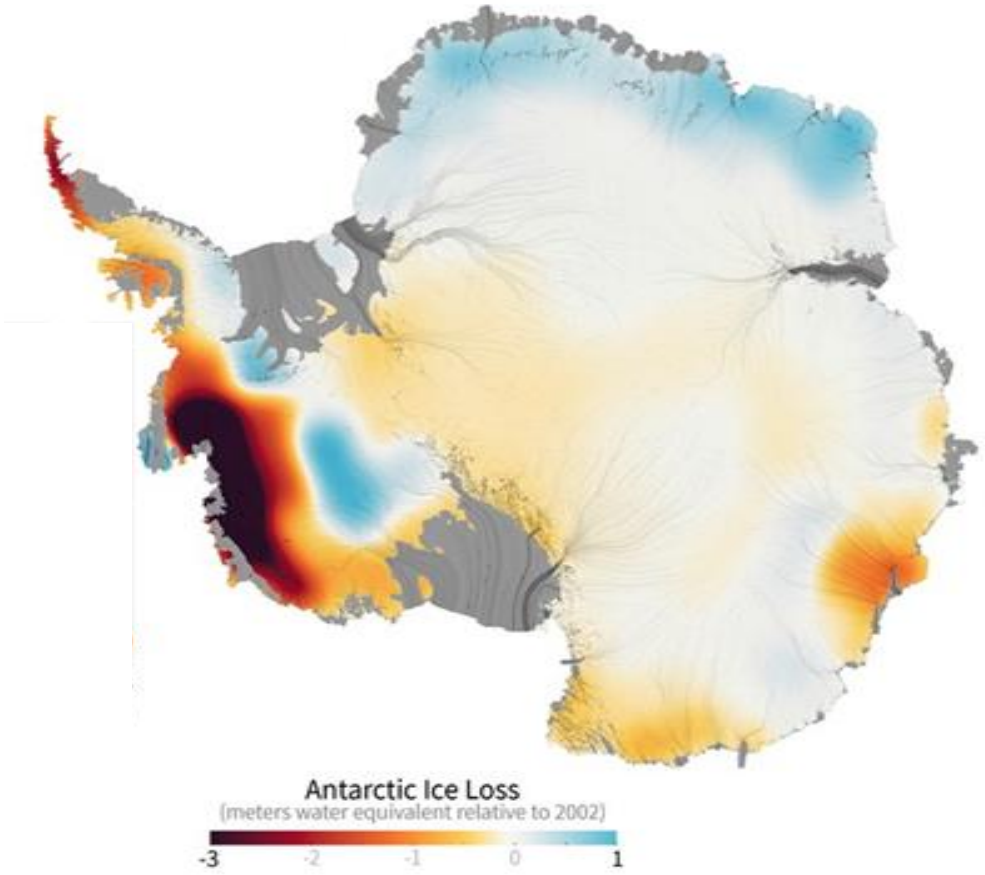


…with a very strong asymmetry

Kopp et al., *Earth's Future, 2014*

Oceanic Perimeter is Key



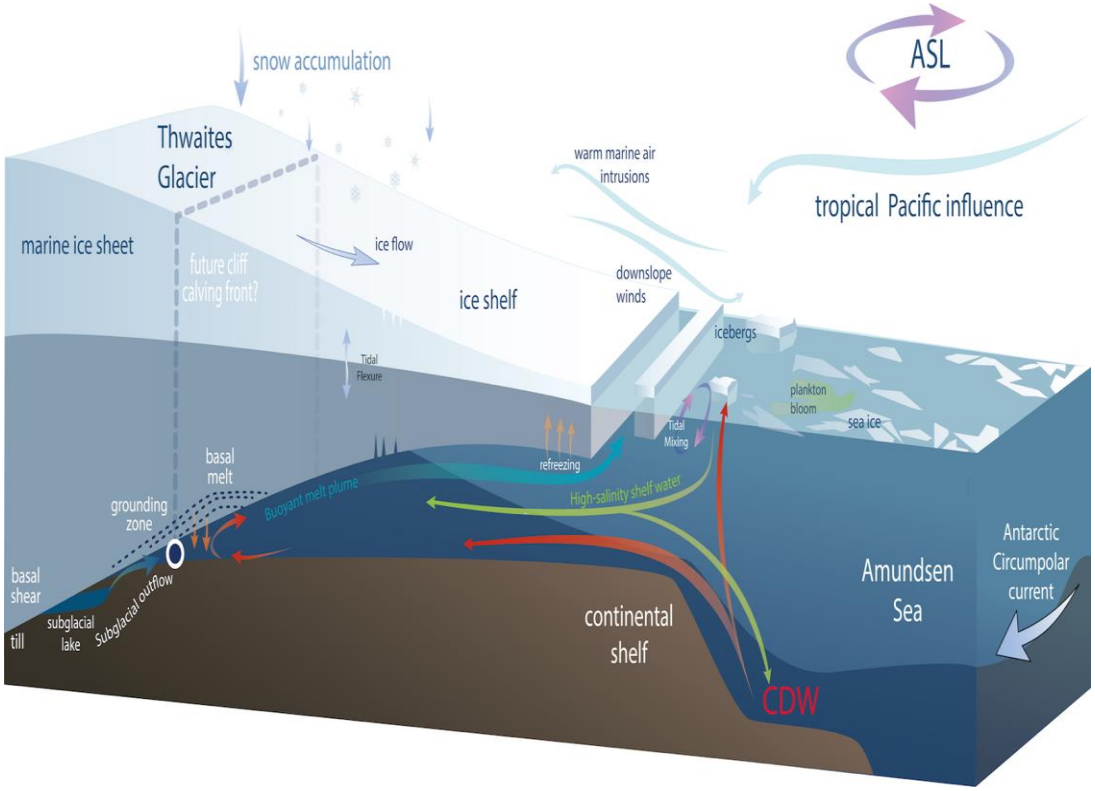


Ice sheets HATE water!

Complex dynamics at the floating edge of an ice sheet

Marine Ice Cliff Instability
(Example: Helheim Glacier, Greenland)

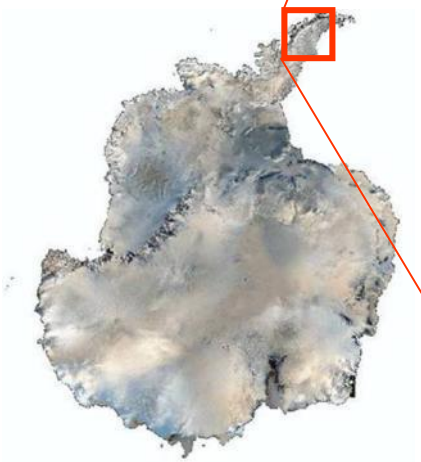
Marine Ice Sheet Instability
(Example: Thwaites Glacier, Antarctica)

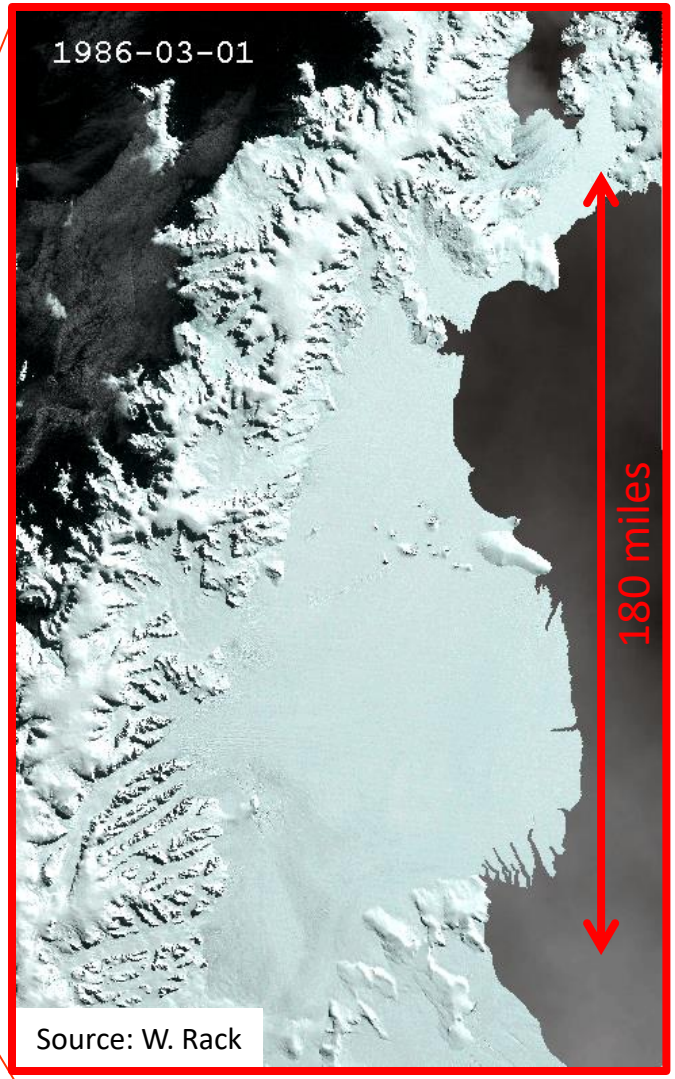


Ice Shelves Buttress Ice Sheets

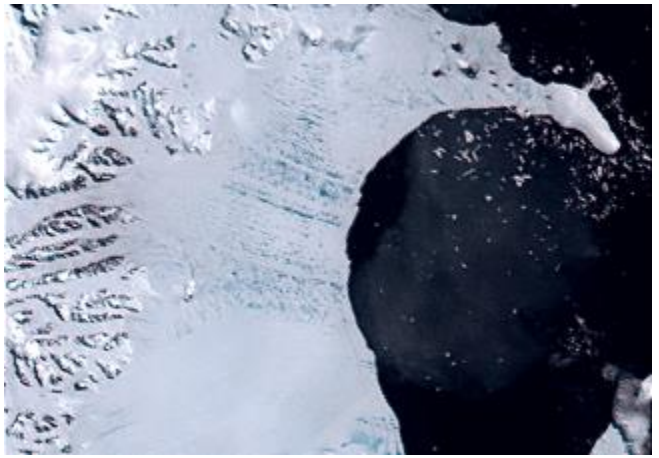
Require >10,000 years to form

Disintegrate in weeks



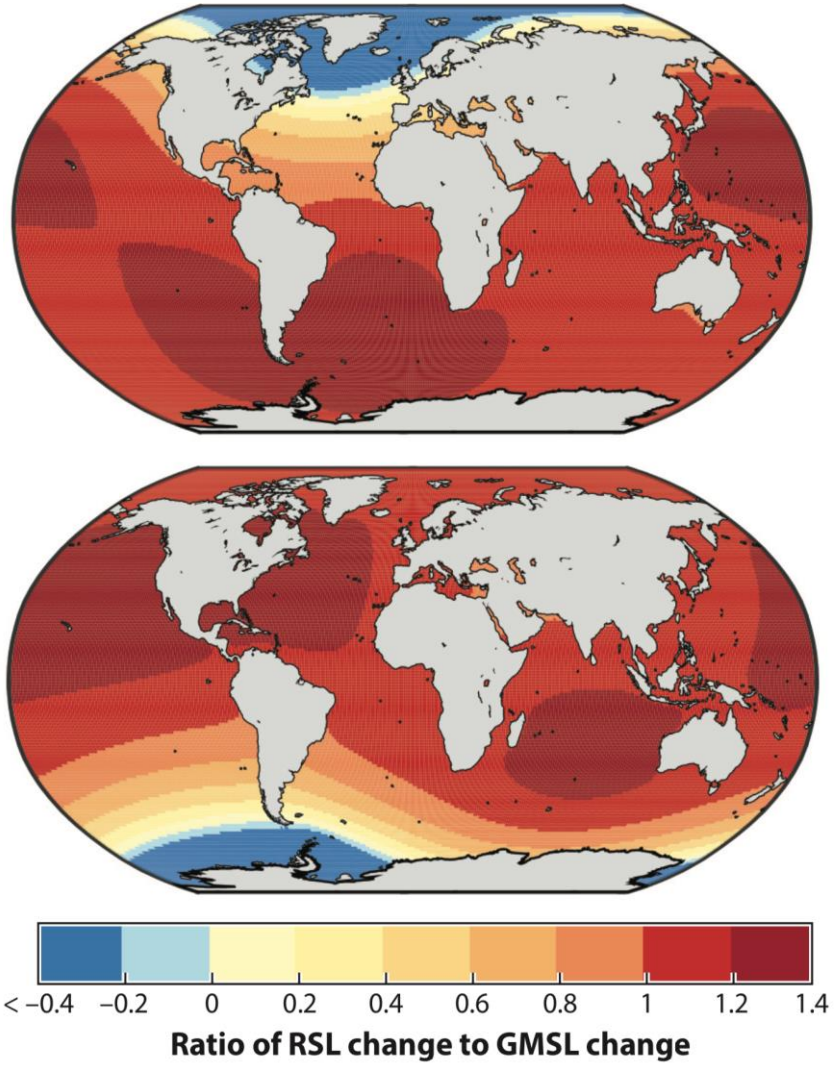


Source: W. Rack



180 miles: Seattle to Portland

Sea level rise will not be evenly distributed

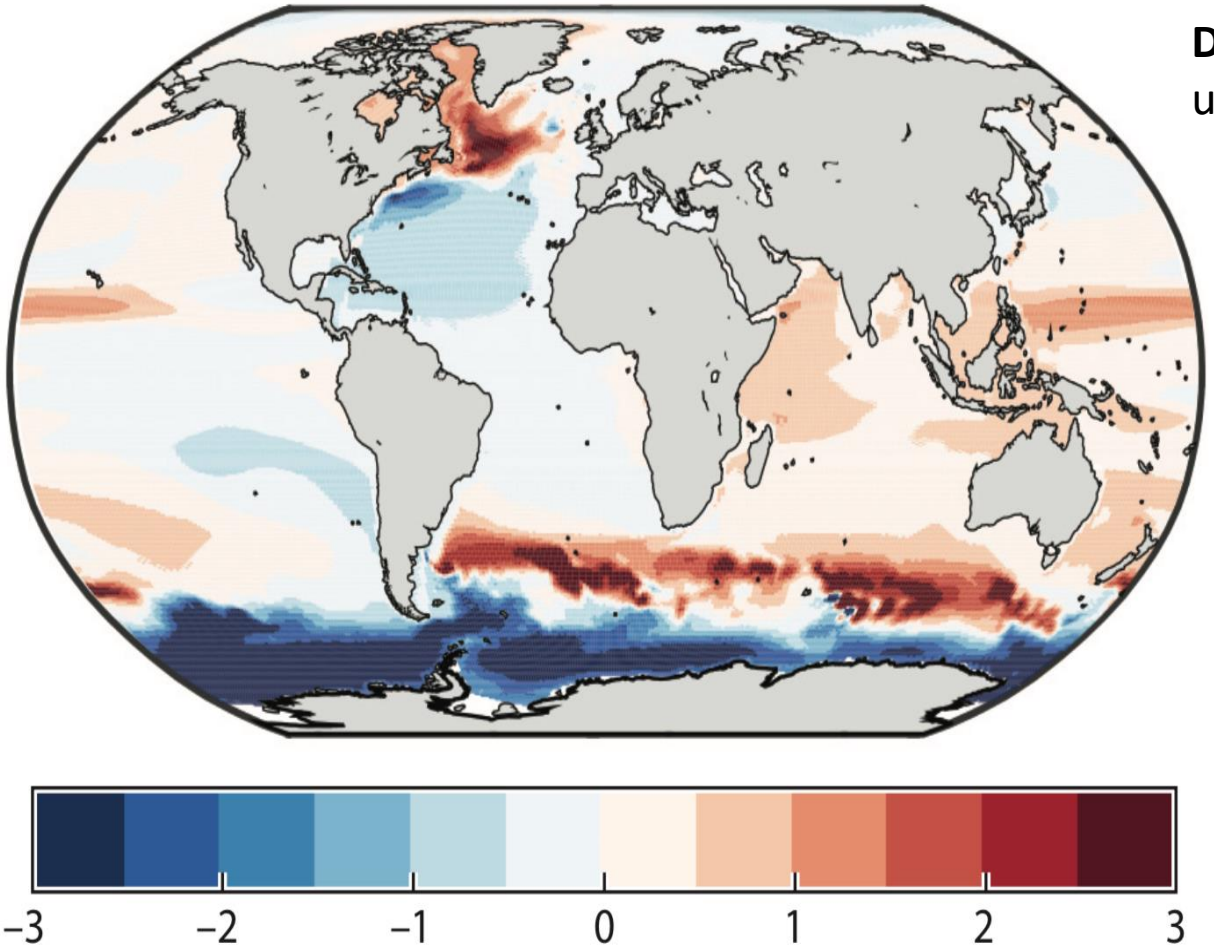


Sea level rise due to ice loss from **Greenland Ice Sheet** under RCP8.5, mm/year

Sea level rise due to ice loss from **West Antarctic Ice Sheet** under RCP8.5, mm/year

Horton et al., *Ann Rev Env Resour, 2018*

Sea level rise will not be evenly distributed



Dynamic sea level change
under RCP8.5, mm/year

Horton et al., *Ann Rev Env Resour, 2018*

Summary

- SLR projections are very complex and highly dependent on future GHG concentrations
- Major additional uncertainty in land-ice contributions to SLR result from complex dynamics at the oceanic edges of ice sheets
  - Strongly asymmetric (slightly better or much worse are equally probable)
- Progress is being made
  - field studies are ongoing, but challenging
- Source of land-ice contributions matters--A LOT!

Thank you!

Questions?

Updates from the shoreline: Addressing sea level rise impacts in King County

LARA WHITELY BINDER
CLIMATE PREPAREDNESS SPECIALIST
KING COUNTY

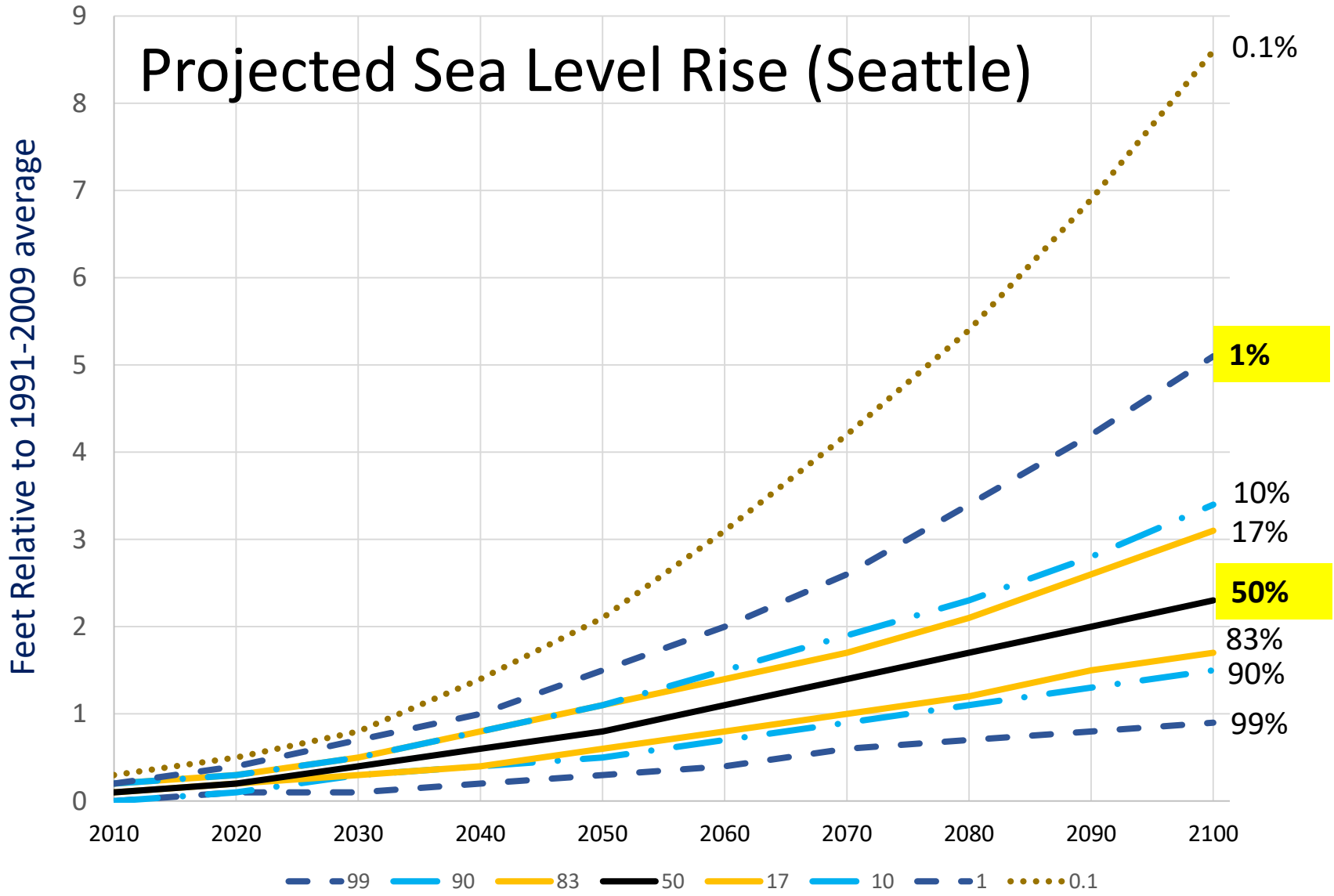
CHRN Annual Meeting
June 5, 2019

King County
CLIMATE ACTION
Clean Future. Strong Communities.

Random Actions of Adaptation (2007-present)

- **Remapped** coastal (and riverine) floodplains.
- **Raised base elevation** for new construction to three feet above the 100-yr flood elevation.
- **Consider** sea level rise in public infrastructure projects.
- **Consider** sea level rise in shoreline restoration projects.
- **Notify** developers about sea level rise.
- **Encourage** project developers to consider sea level rise.
- **Assessed** options for coastal roads on Vashon Island.
- Multiple **impact assessments** on wastewater conveyance infrastructure
- **Sea level rise mapping (2 and 5 feet)**
- **Impact assessments for King County-owned assets (ongoing)**
- **Developing a strategy for sea level rise (ongoing)** – includes proposed code changes

“Picking the Number(s)” for King County



Probability of exceedance value =

% probability that sea level rise will be *higher* than the value shown

Yellow = values King County used in most recent mapping

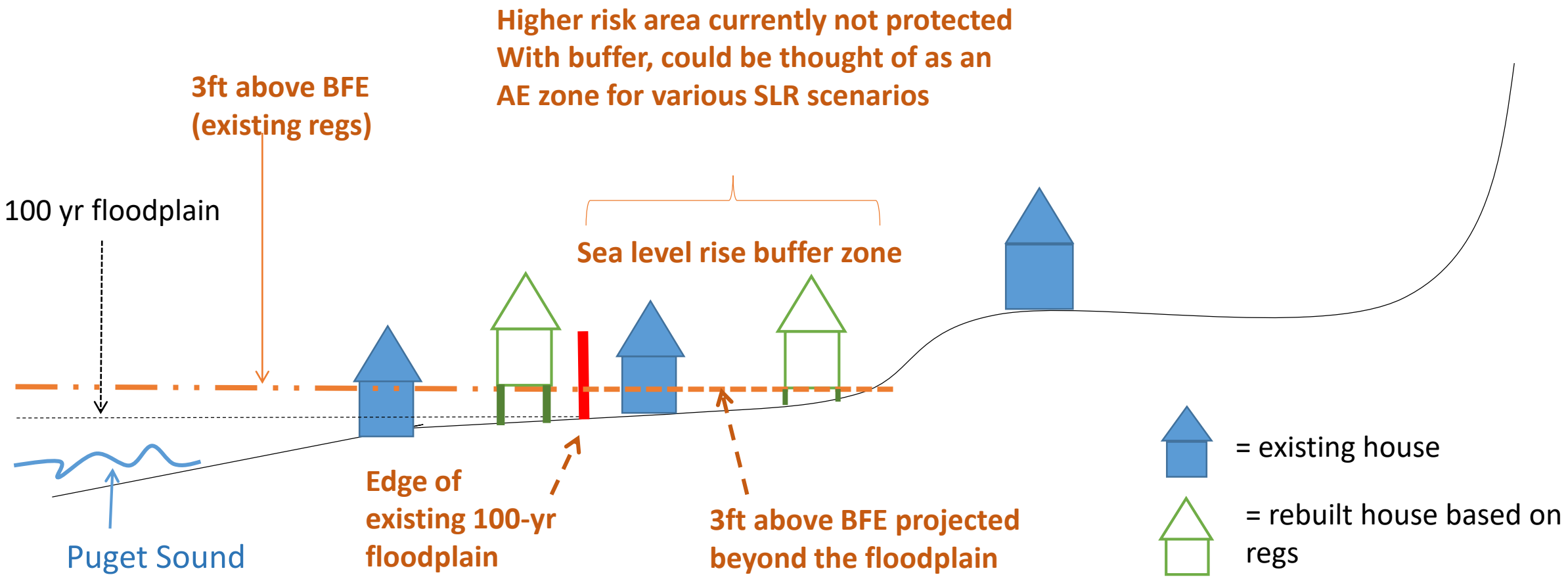
Source: Washington Coastal Resilience Project, Miller et al. (2018)

King County has three different authorities that apply to the marine shoreline (regulatory levers)

- King County is **the local land-use authority** in unincorporated areas *(Comp Plan, SMP, permitting)*
- King County has **public health authority** for on-site sewage systems and drinking water supplies for the entire county *(Heath Code, permitting)*.
- King County implements certain **floodplain management and flood risk reduction authorities** for the entire county via agreement with the King County Flood Control District *(Flood Hazard Management Plan)*.

Addressing Changes in Coastal Flood Risk

Key Proposal: Create a new "Sea Level Rise Buffer Zone" and set requirements within this new zone



Other proposed changes related to coastal flood risk

Strengthen requirements for coastal 100-year floodplain

Groundwater wells:

- No new wells in the coastal floodplain
- All new wells in the SLR buffer zone need to have well casing that extends to +3 feet BFE
- Substantial improvements in floodplain or SLR buffer = well must be moved or retrofitted to +3 feet BFE standard

Similar provisions for onsite septic (in Public Health code)

Addressing Erosion and Bulkheads

Addressing Erosion and Bulkheads (Vashon/Maury Isl.)

Trends?

- Difficult to see trends in erosion; event-driven
- Getting more questions about SLR
- Seeing more retaining walls popping up

***Encouraging* erosion is a priority**

- Focusing on 4-5 drift cells but still opportunistic; timing will sellers in target areas with available $$
- SLR "relatively easy to incorporate" in VMI restoration – pulling infrastructure out

Changing demographics:

- Longtime, aging owners (not all wealthy) with bulkheads reaching a certain age.
- More Air B&Bs/2nd homes (anecdotally)

Proposed Comp Plan Changes: Erosion & Bulkheads (in review)

Increased setback requirement for bluffs that extend into the coastal high hazard area or the SLR buffer:

- Establish 75 feet as the standard setback on top of steep slopes for new construction (was 50 feet).
- Allow for 50-foot setback if geotechnical report demonstrates 50 years of erosion potential.
- Require geotechnical reports to account for increased erosion and landslide rates due to sea level rise.

Notable: The one provision where we have to define an amount of SLR and a rate

Proposed Comp Plan Changes: Erosion & Bulkheads (in review)

Strengthen bulkhead requirements for developed parcels

- Increase toe of bulkhead elevation requirement to three feet above the Mean Higher High Water elevation level.
- If not feasible, require structure to be elevated to 3 feet above the 100-year floodplain elevation OR moved back to allow for 50 years of erosion so bulkhead is not needed.
- If the cost of elevating or moving the structure is less than the cost of the bulkhead, construction of the bulkhead “shall not be approved”
- If elevating or moving structure is not feasible, then allow toe of bulkhead to be as low as the Mean Higher High Water elevation.

NEXT STEPS

Comp Plan Changes

- Public meeting on Vashon specifically to discuss SLR and Rrelated proposed Comp Plan changes (July 2)
- Transmittal to Executive for review (August) and Council (Sept 30)

Other work

- Investment in USGS CoSMoS modeling (incl. bluff erosion)
- Finish SLR strategy
- 2020 Strategic Climate Action Plan

CoSMoS domain for King County study

Learn more at:
www.kingcounty.gov/climate

King County
CLIMATE ACTION
Clean Future. Strong Communities.

LARA WHITELY BINDER

Climate Preparedness Specialist

lwbinder@kingcounty.gov

206.263.0825

Sea Level Rise Hazard Mapping, Decision Tools, & Data

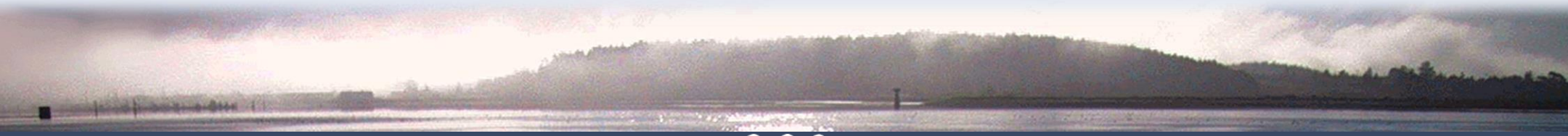
Tools to evaluate and communicate about SLR implications

Andrea MacLennan, MS
Senior coastal geomorphologist
Coastal Geologic Services, Inc

June 5, 2019

CHRN Annual Meeting
UW Tacoma

COASTAL GEOLOGIC SERVICES



Overview: Mapping SLR hazards, Decisions Tools, and New Data

SLR Hazard Mapping: SJ County Assessment

How vulnerable is this shore to SLR?

What hazards are present? Where?

Tools for Communicating & Making Decisions

How will my shore respond to SLR?

What are appropriate ways to adapt?

New Data to Inform SLR Planning & Restoration

Where should we focus conservation?

Where should we focus restoration?

San Juan County Assessment

Objectives

- GIS-based assessment of coastal bluff erosion and inundation
  - Identify most vulnerable areas in county
- Friends of San Juans, funded by EPA, completed in 2013.
- SLR projections (NRC 2012):
  - 2050, 2100
  - Medium (0.5 FT, 2 FT) and High scenarios (1.6 FT, 4.7 FT)

San Juan County Assessment

Inundation

- Standard bathtub model
- Created MHHW using Vdatum
- Created contours for HOWL and each scenario and horizon
- Created polygons from lines

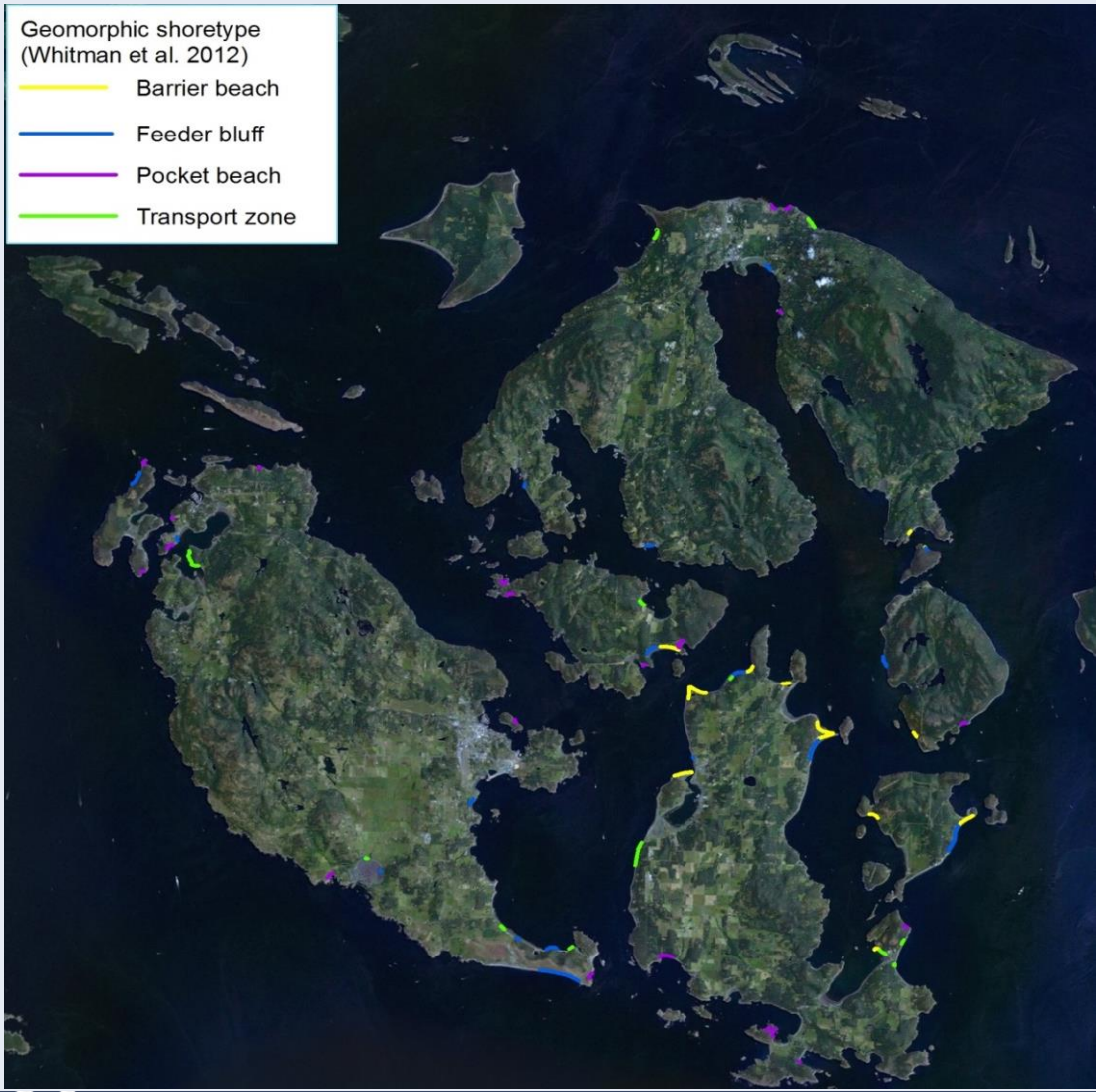
MHHW = Mean Higher-High Water

HOWL = Highest Observed Water Level (at Friday Harbor)

San Juan County Assessment

Coastal Bluff Recession

- Measured background recession rates from stratified sample of 50 shoreforms:
  - Shoretype
  - Wave exposure
- 1960s - 2009
- DSAS
- Digitized bluff crest from LIDAR slope data

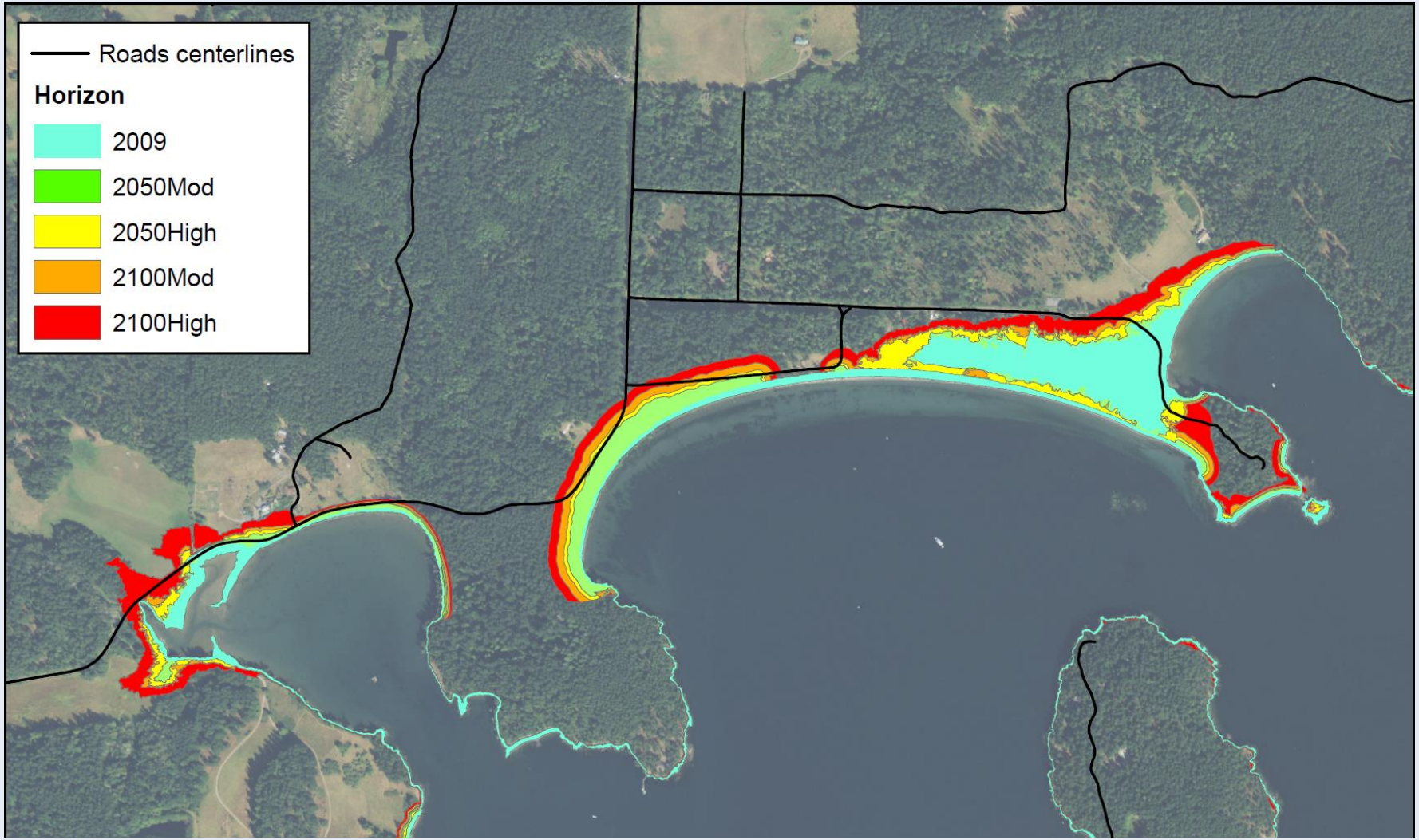


Bluff Recession Buffers

- Different shoreforms erode at different rates
  - Feeder bluffs and transport zones/pocket beaches
  - Accretion shoreforms too variable to map
  - Exposure significant
- Bluff recession rates will accelerate with SLR
  - Rate of SLR
- Future erosion was buffered from bluff crest
  - Shoreform (2 shoretypes, 2 exposure categories)
  - Scenario (Mod, High)
  - Planning horizon (2050, 2100)
- Buffers truncated by bedrock geology

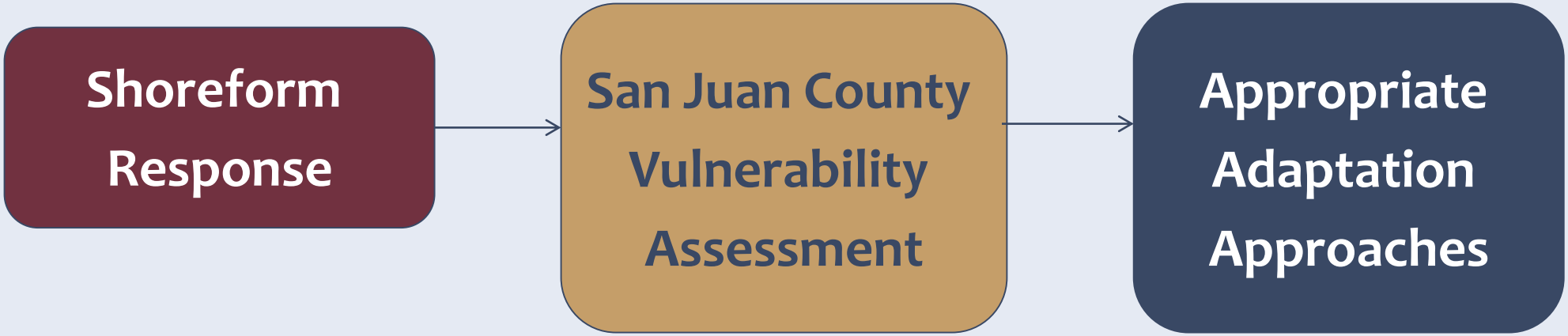
San Juan County Assessment

Results



Tools for Communicating & Making Decisions

Objective: Make informed decisions

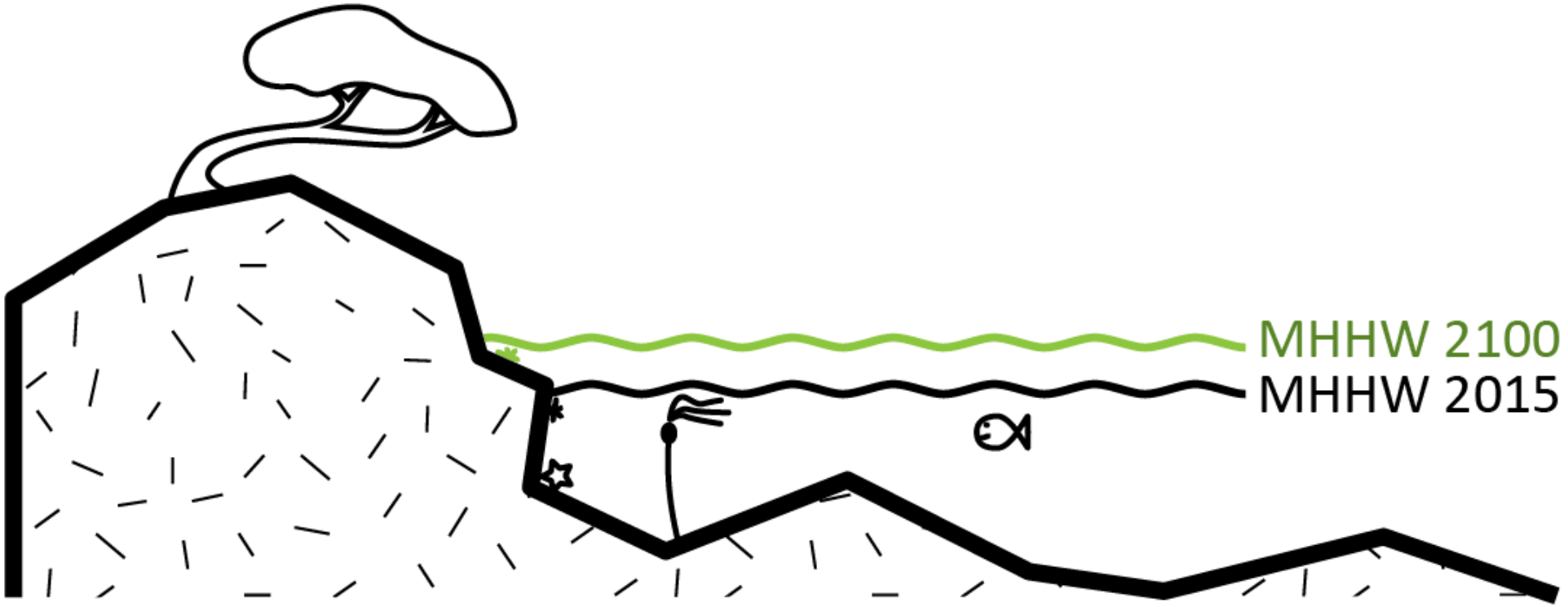


How will my shoreline respond to sea level rise?

How vulnerable is my property? What type of hazard? When?

What are appropriate responses for my type of shoreline? What can I do about it?

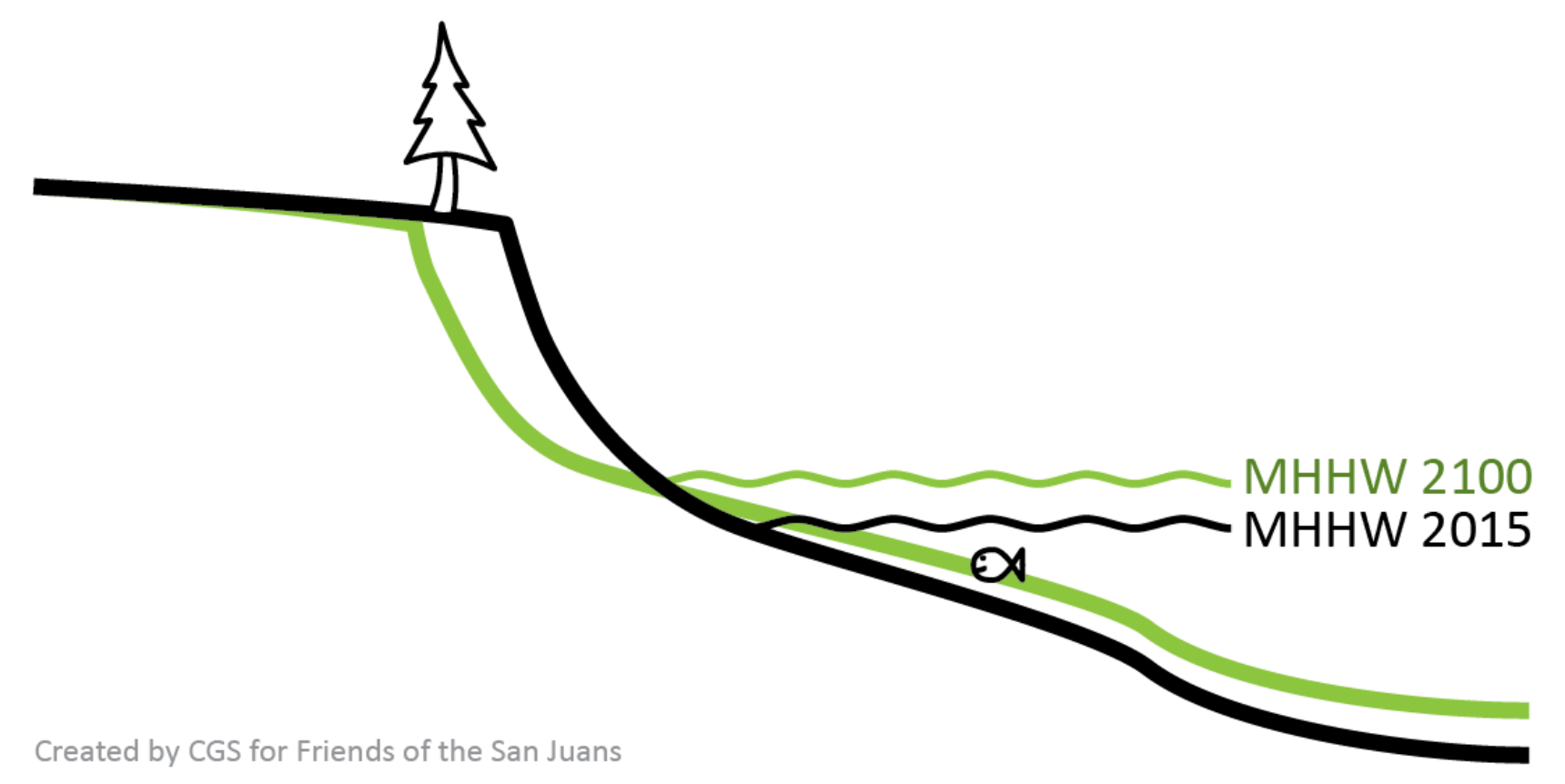
Shoreform Response – Rocky Shores



Vertical shift upwards/landward shift in tidal elevation

Similar shift in intertidal habitats

Shoreform Response – Bluffs



Landward shift of entire beach profile

Bluff erosion enables local and down-drift beaches to adjust

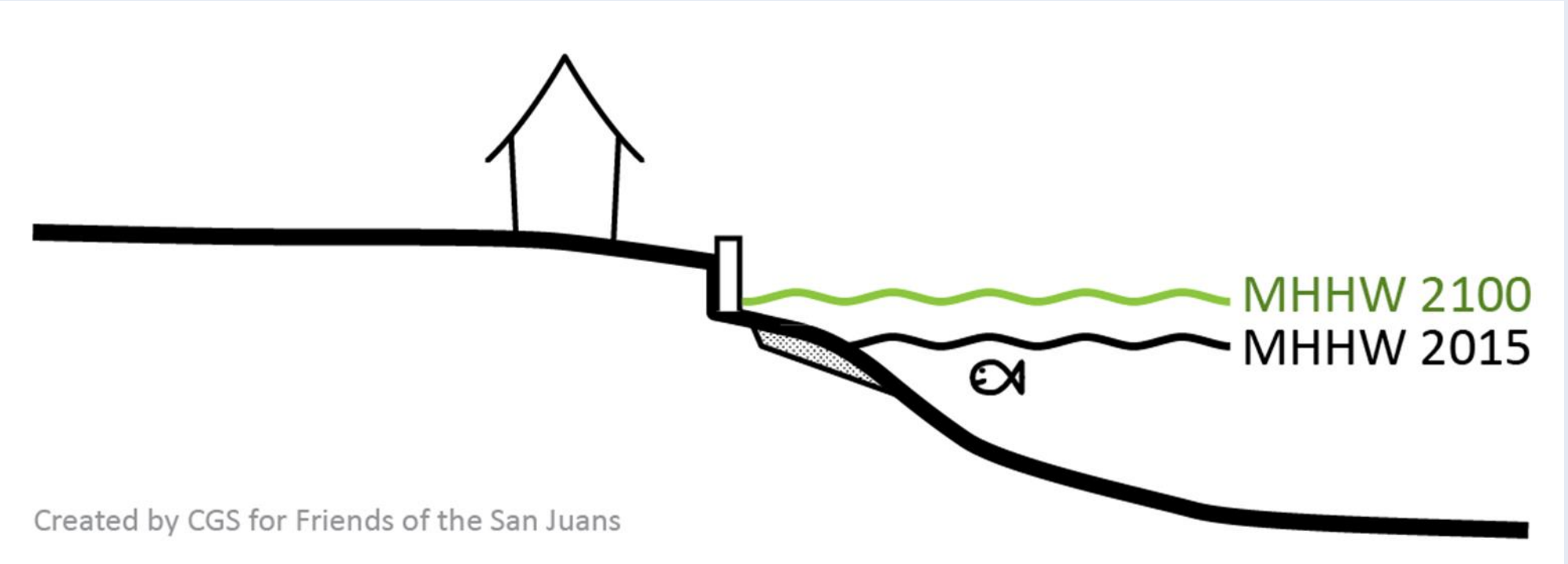
Shoreform Response – Barrier Beaches

Crest of berm will build higher and shift landward via overwash

Landward shift in habitats, dune grass, driftwood, intertidal spawners

Habitat/beach loss can occur where landward constrains limits natural migration of beach features

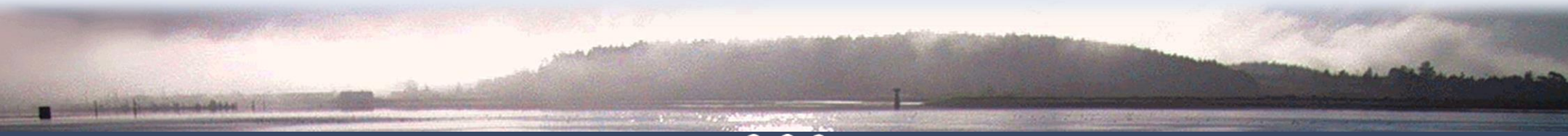
Shoreform Response – Armored



Static shoreline armor prevents landward migration of shoreline and habitats resulting in habitat and beach loss

Appropriate Adaptation Approaches

- Geomorphic response
- Planning horizon
- Cost of infrastructure
- Maintenance
- Opportunities
  - Habitat conservation / restoration
  - Increased resilience

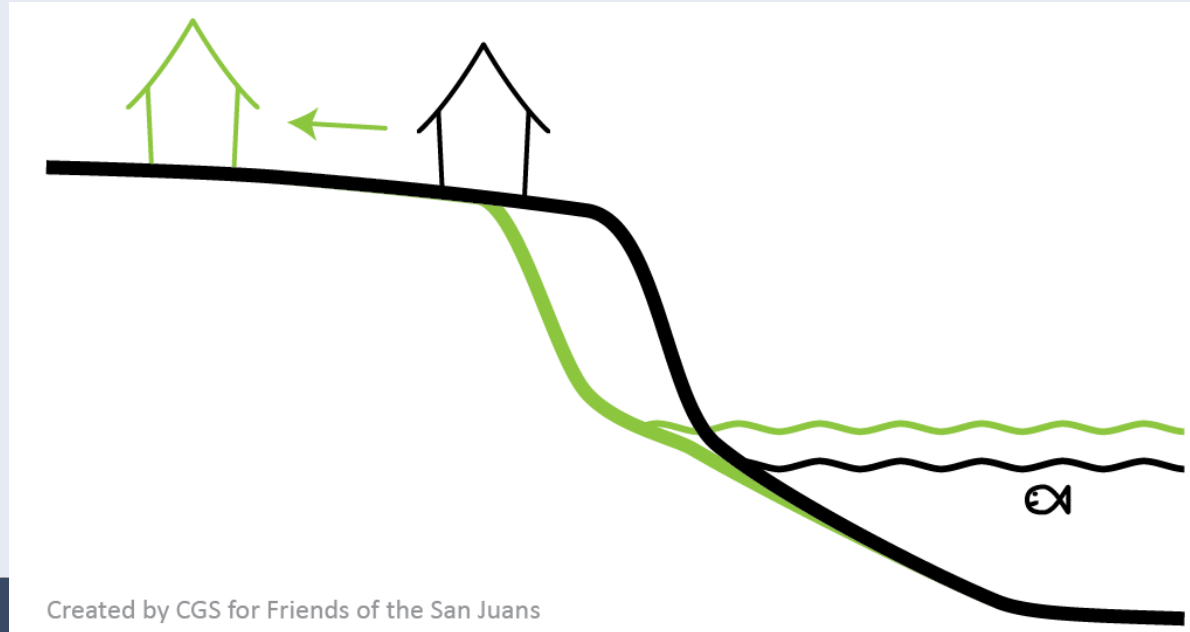


Appropriate Adaptation Approaches - Relocate

Created by CGS for Friends of the San Juans

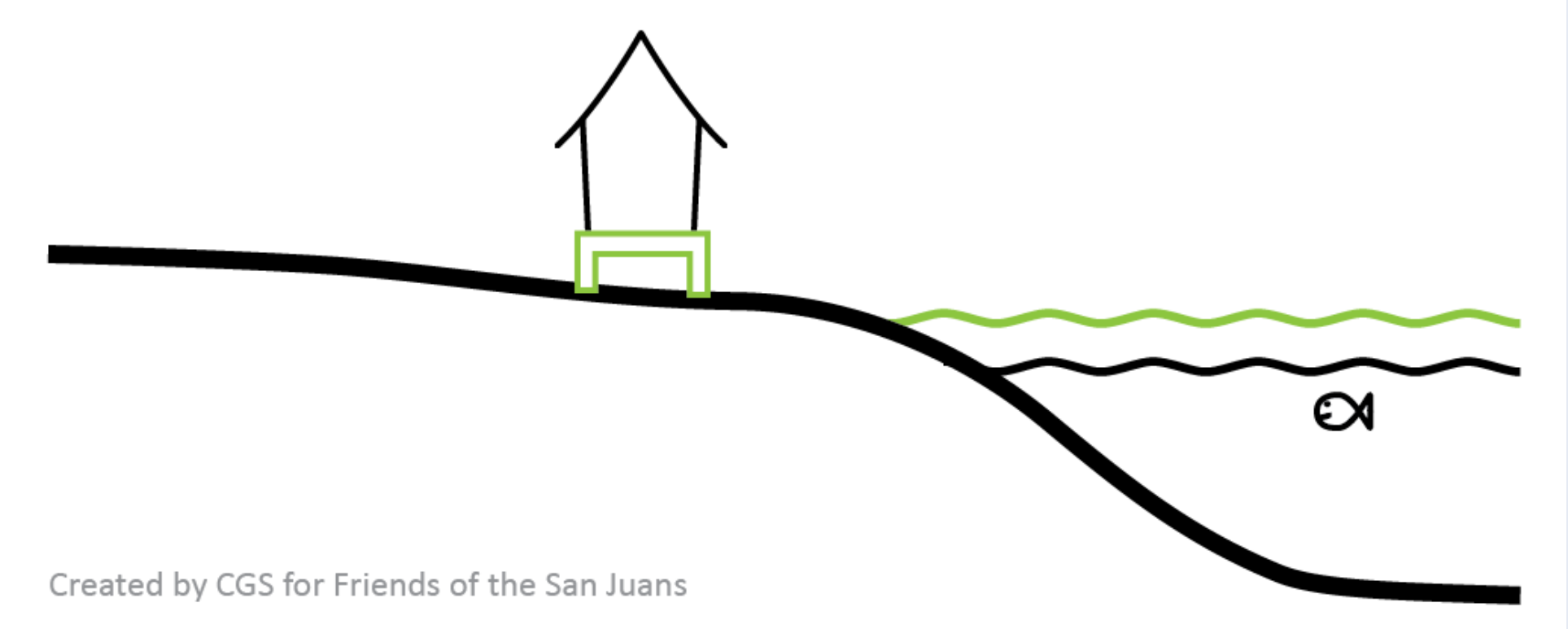
- Effective for managing erosion and inundation in the long-term
- Requires adequate upland area for relocation

- Often cheaper than engineered solutions
- Most effective for septic, outbuildings, and highly vulnerable primary structures



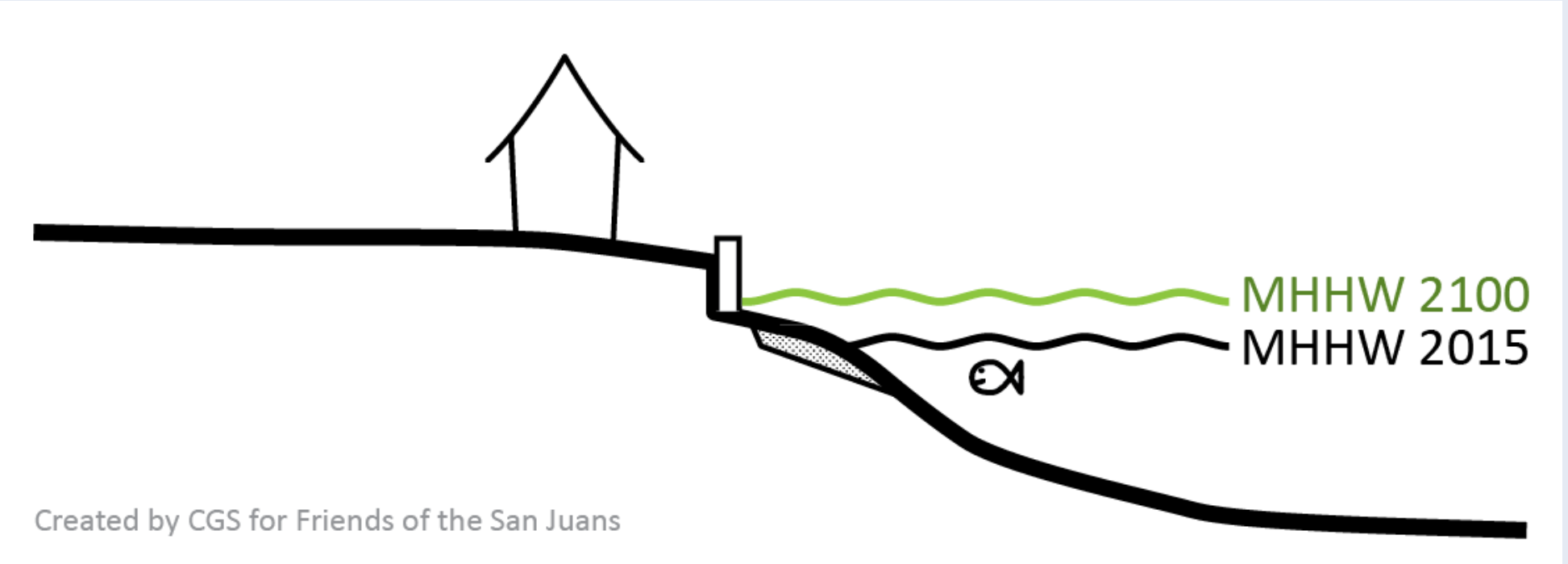
Created by CGS for Friends of the San Juans

Appropriate Adaptation Approaches - Elevate



- Only effective for managing coastal flooding, not erosion
- Driftwood can damage pilings, elevated structures etc.

Appropriate Adaptation Approaches - Fortify

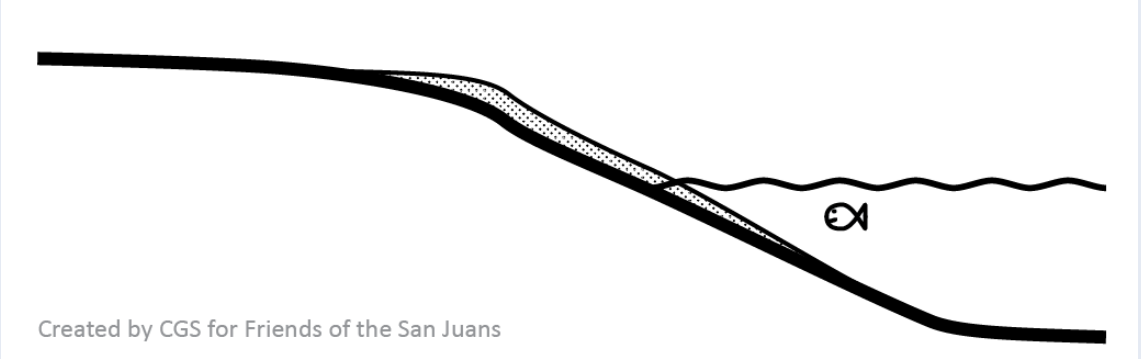


Shore armor has limitations:

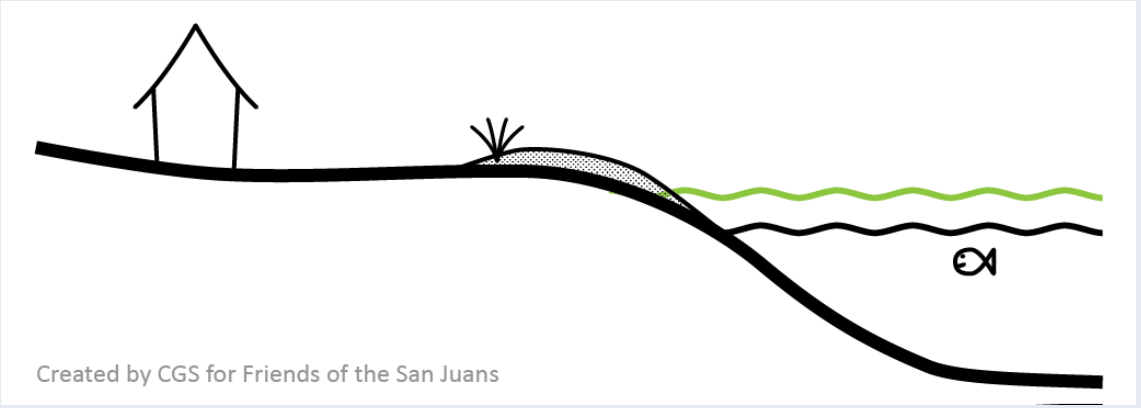
- **Only effective for managing erosion, not flooding**
- **Will not curb all bluff erosion**
- **Will lead to beach habitat loss**

Appropriate Adaptation Approaches - Nourish

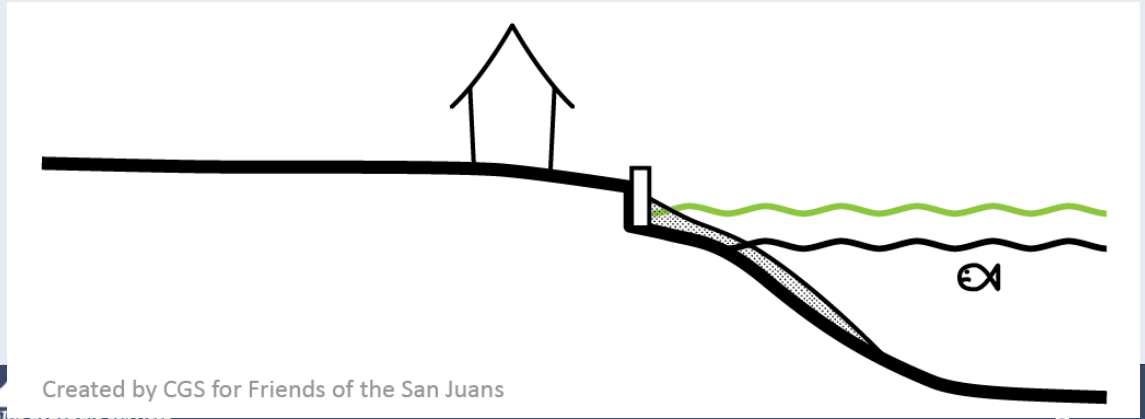
- Nourish entire beach profile



- Build a storm berm, to absorb wave energy



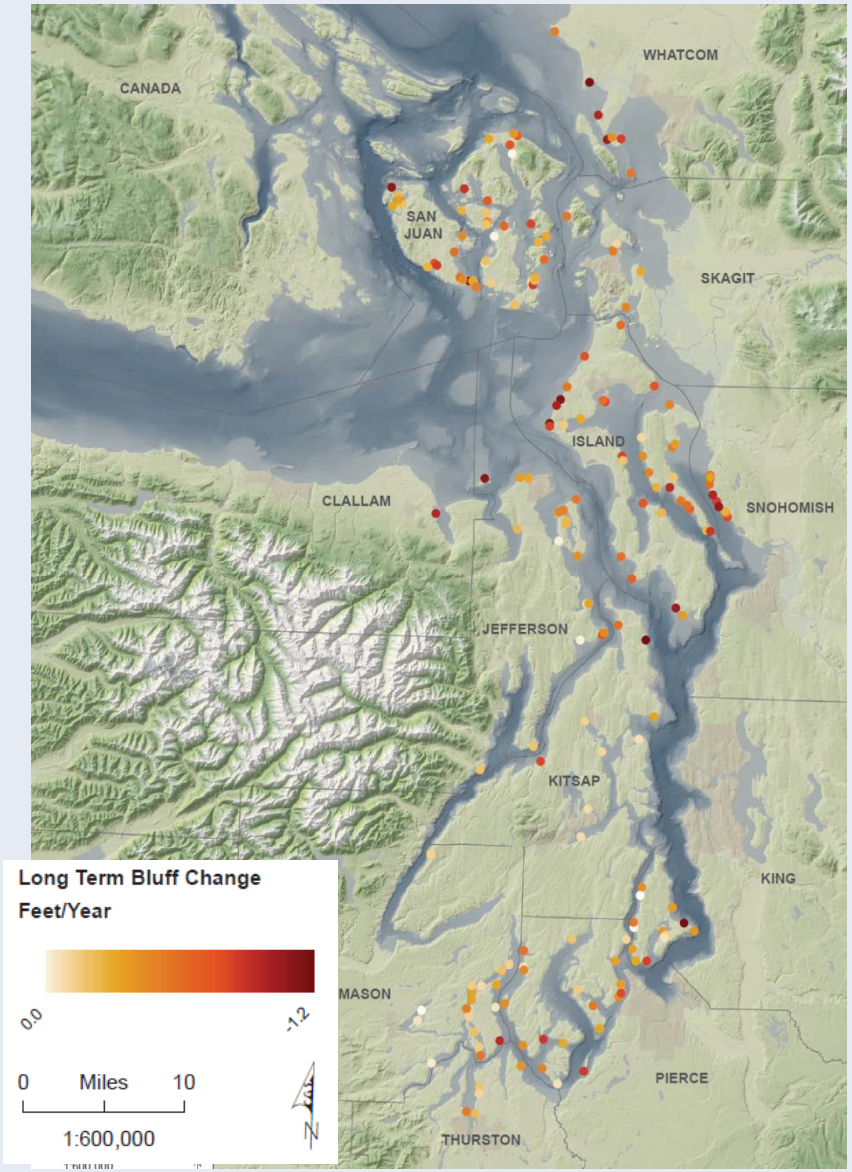
- Compensate (short-term) for lost sediment supply or habitat loss



New Data for SLR Planning & Restoration

Plan for accelerated erosion rates

- ***Long-term bluff recession rates will increase***
  - Increase precipitation
  - More frequent “change events”
  - Higher water levels
- **Accelerated erosion tied to rate of SLR**
  - Uncertainty in WAIS melt



Download the CGS Bluff Recession report:
http://coastalgeo.com/publications/bluffrecession/

New Data for SLR Planning & Restoration

Beach Strategies Geodatabase – Phase 1 Obtain from WDFW

- **Updated Shoretype Mapping**
  - Includes historic shoretypes for all armored shores
- **Updated drift cell mapping**
  - With linear referencing routes for drift direction
- **Updated shore armor mapping**
  - Ltd additional data on: toe elevation, condition,
  - Additional armor mapping info: data age, resolution, etc

New Data for SLR Planning & Restoration

Beach Strategies Geodatabase – Phase 2 available in late 2019

- Identify priority beaches for conservation & restoration
  - Sediment Supply
  - Forage Fish Spawning
  - Embayment Support
  - Pocket Beaches
- Multi-scalar, nested geographies
- Queries describing on-the-ground conditions. No black box.
- Linked with hypothesis, justification and supporting principles


Want to learn more?
andrea “at” coastalgeo.com

Nature-Based Dynamic Revetment for Shoreline Stabilization at North Cove

George Kaminsky, Heather Weiner, Diana McCandless, Amanda Hacking

Washington State Department of Ecology

Coastal Monitoring & Analysis Program

North Cove – Shoreline change

June 1990

August 2016

Google Earth imagery


April 6, 2010
April 8, 2016
2009
GELF
2006
2015 N

1999

2005

2006

2009

2011

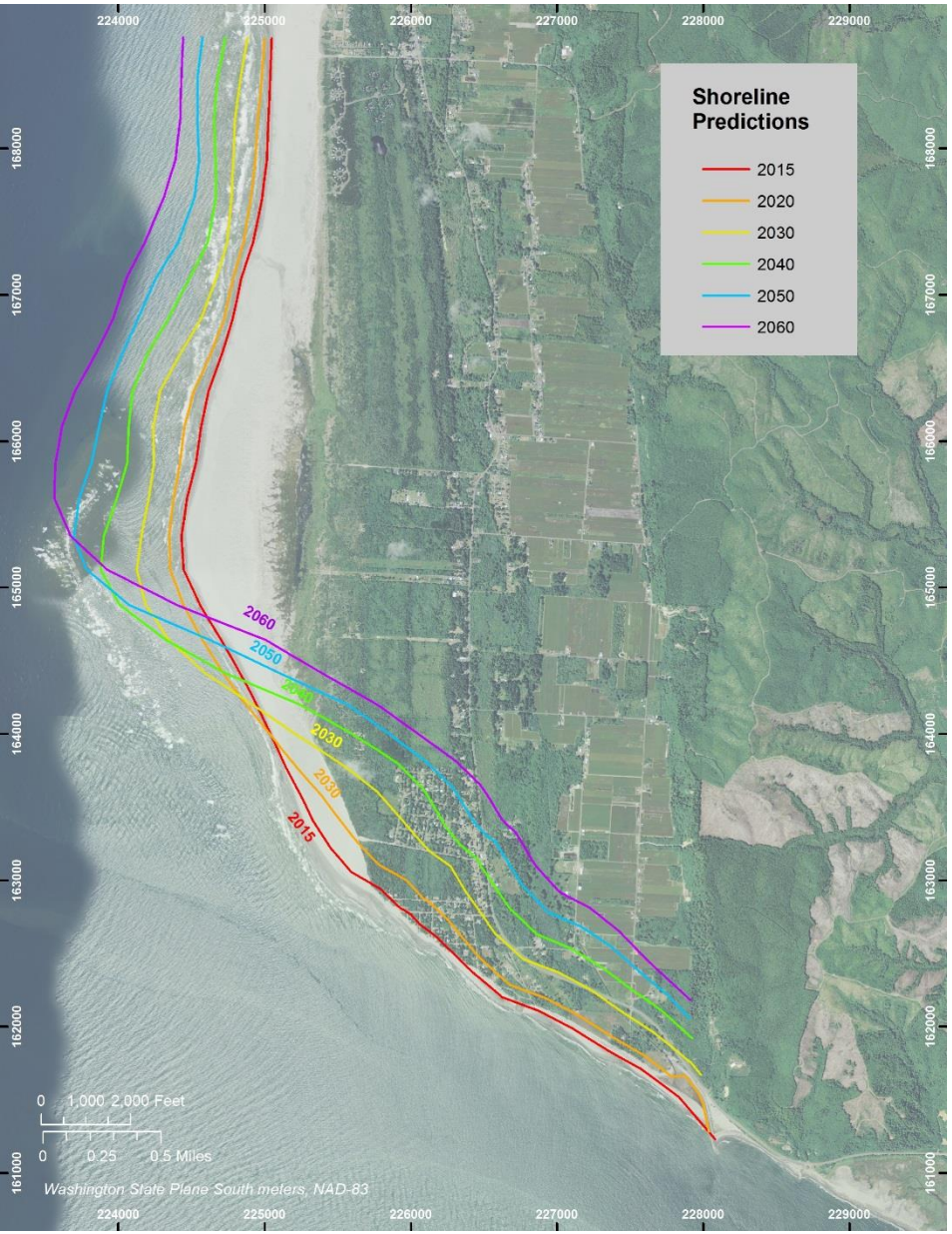
2013

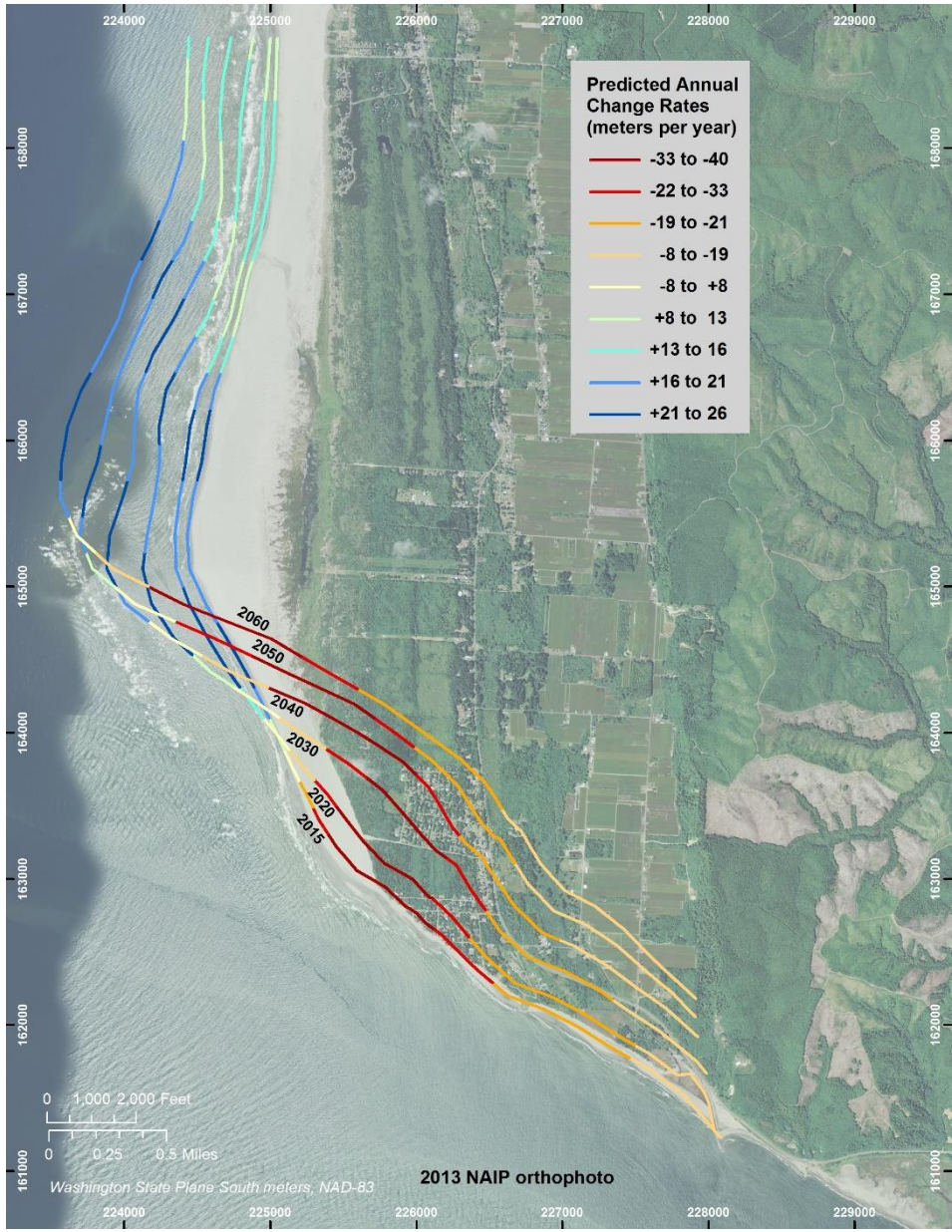
2015

2017

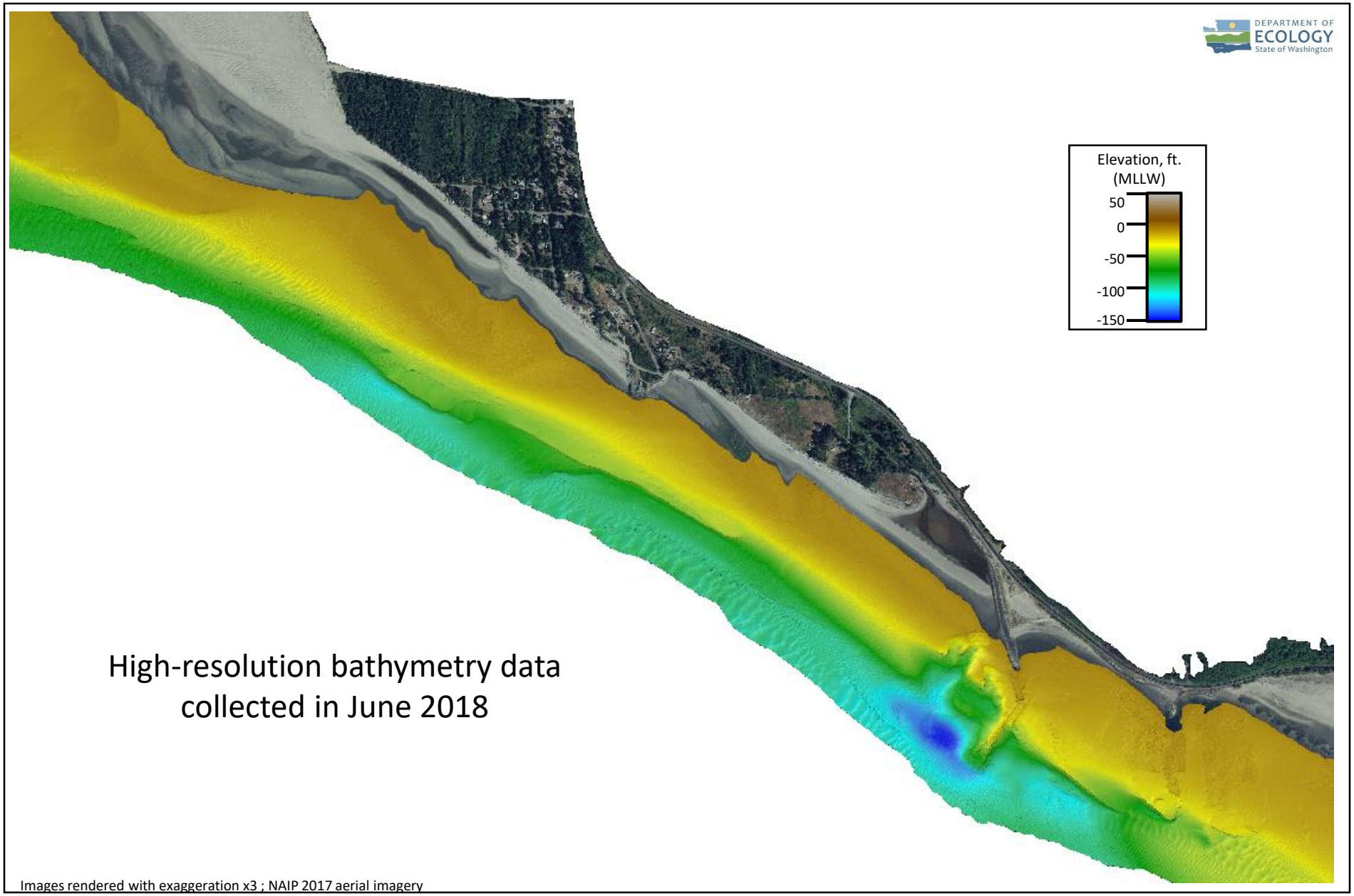

N
W
E
S
Willapa Bay
0
0.125
0.25 Mile
USDA FSA APFO Aerial Photography Field Office

North Cove – Shoreline change predictions





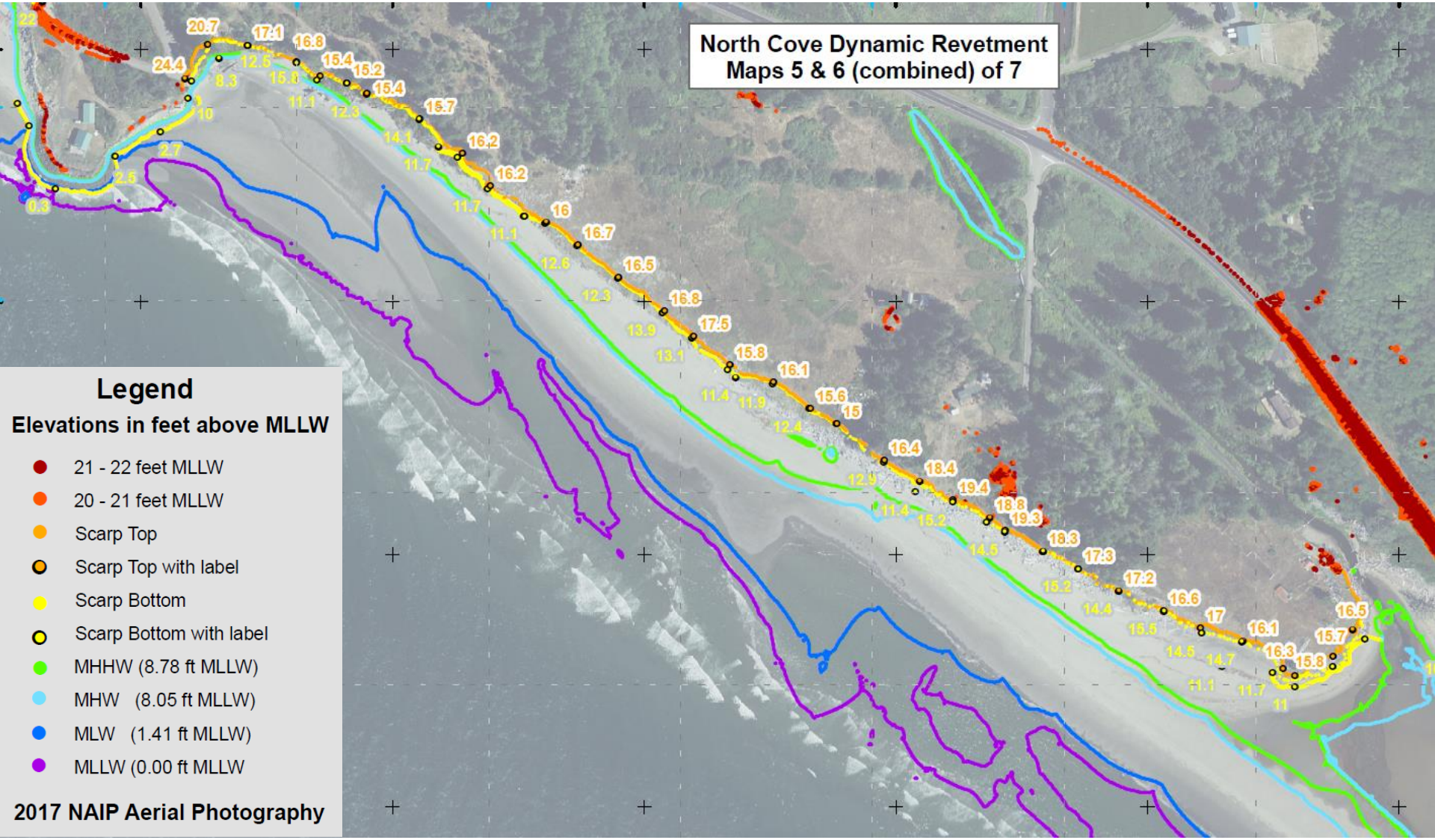
Washington State Department of Ecology Coastal Monitoring & Analysis Program (2016)

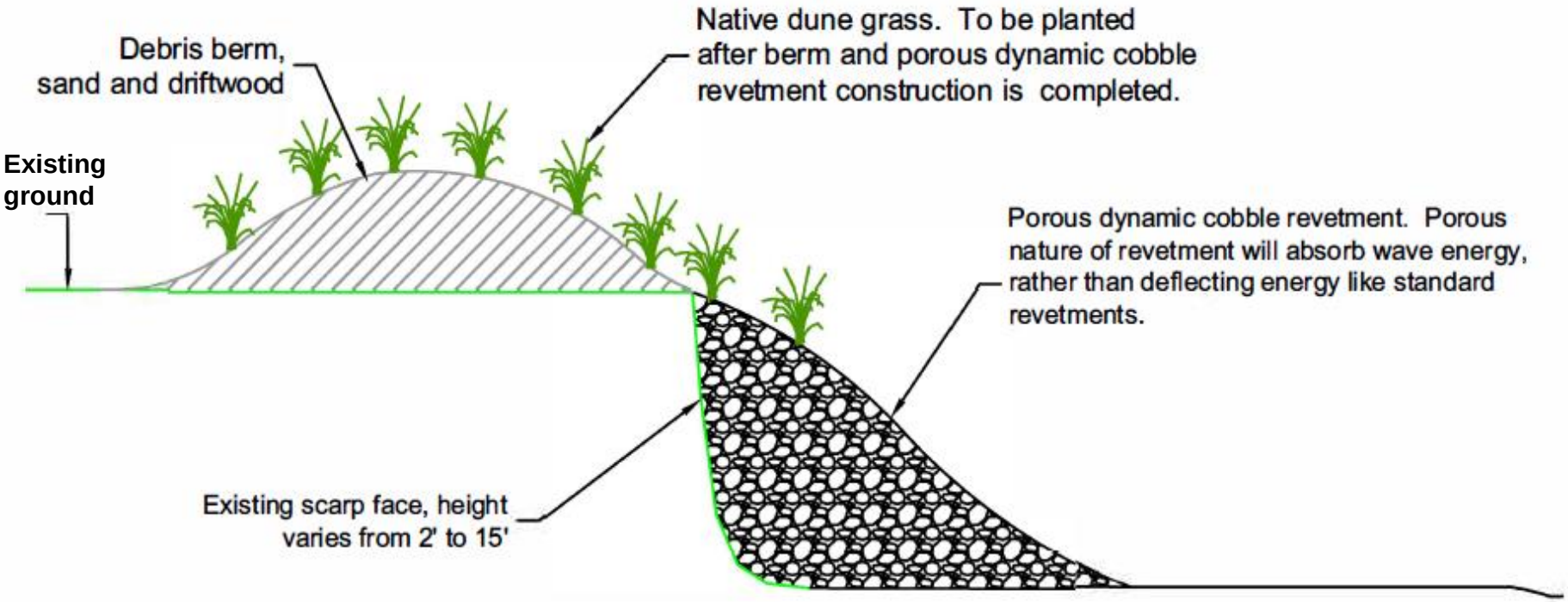

DEPARTMENT OF
ECOLOGY
State of Washington
Elevation, ft.
(MLLW)
50
0
-50
-100
-150
High-resolution bathymetry data
collected in June 2018
Images rendered with exaggeration x3 ; NAIP 2017 aerial imagery

Natural cobble berm vs. built dynamic revetment

Kalaloch Beach 1

North Cove


North Cove Dynamic Revetment
Maps 5 & 6 (combined) of 7
Legend
Elevations in feet above MLLW
21 - 22 feet MLLW
20 - 21 feet MLLW
Scarp Top
Scarp Top with label
Scarp Bottom
Scarp Bottom with label
MHHW (8.78 ft MLLW)
MHW (8.05 ft MLLW)
MLW (1.41 ft MLLW)
MLLW (0.00 ft MLLW
2017 NAIP Aerial Photography



Pacific Conservation District, 2018

North Cove – Dynamic revetment pre- and post-storm

Before

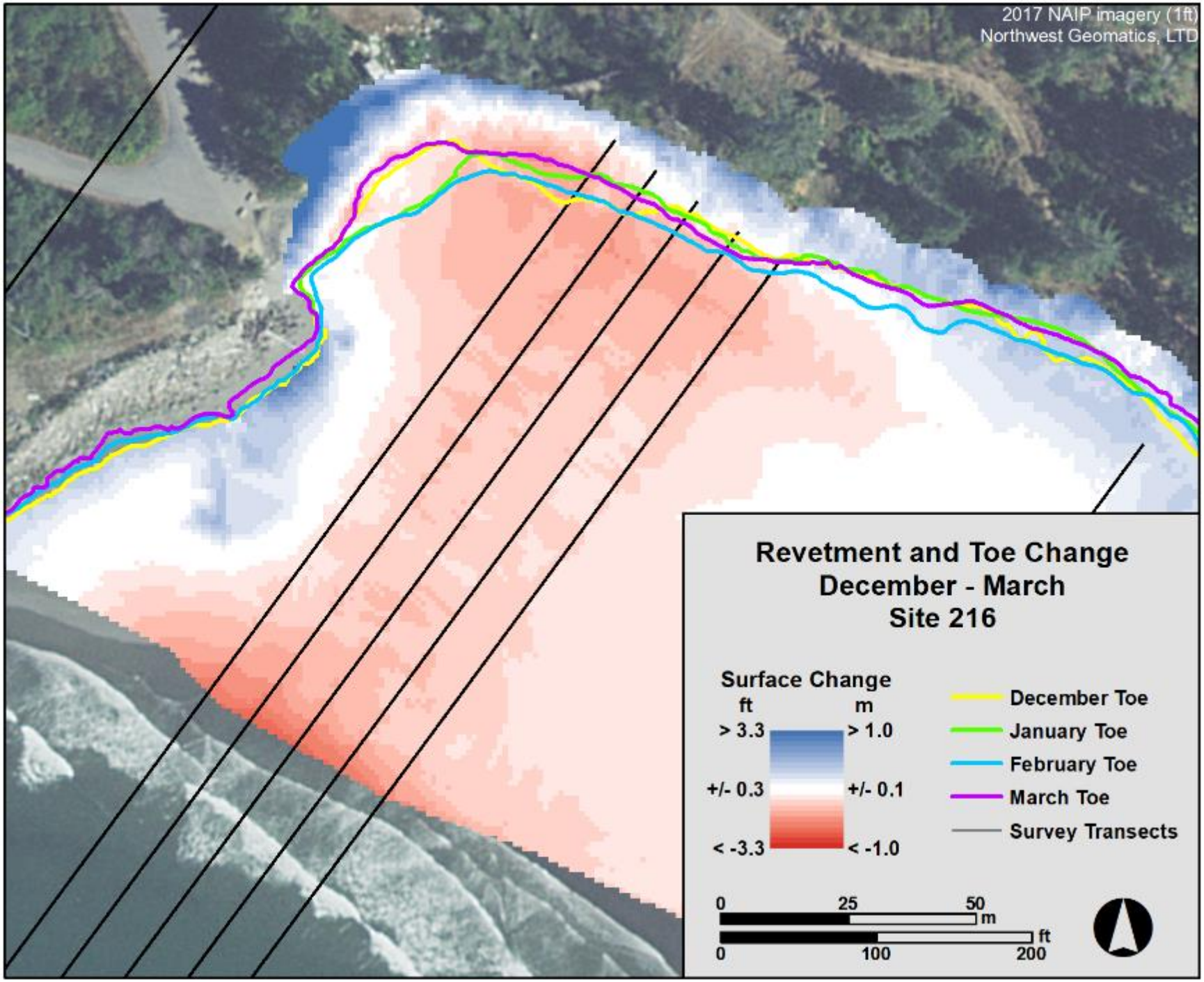
After

Cobble settled and upper bank exposed; ~30 ft. of scarp lost, exposing the trailer seen in the photo.

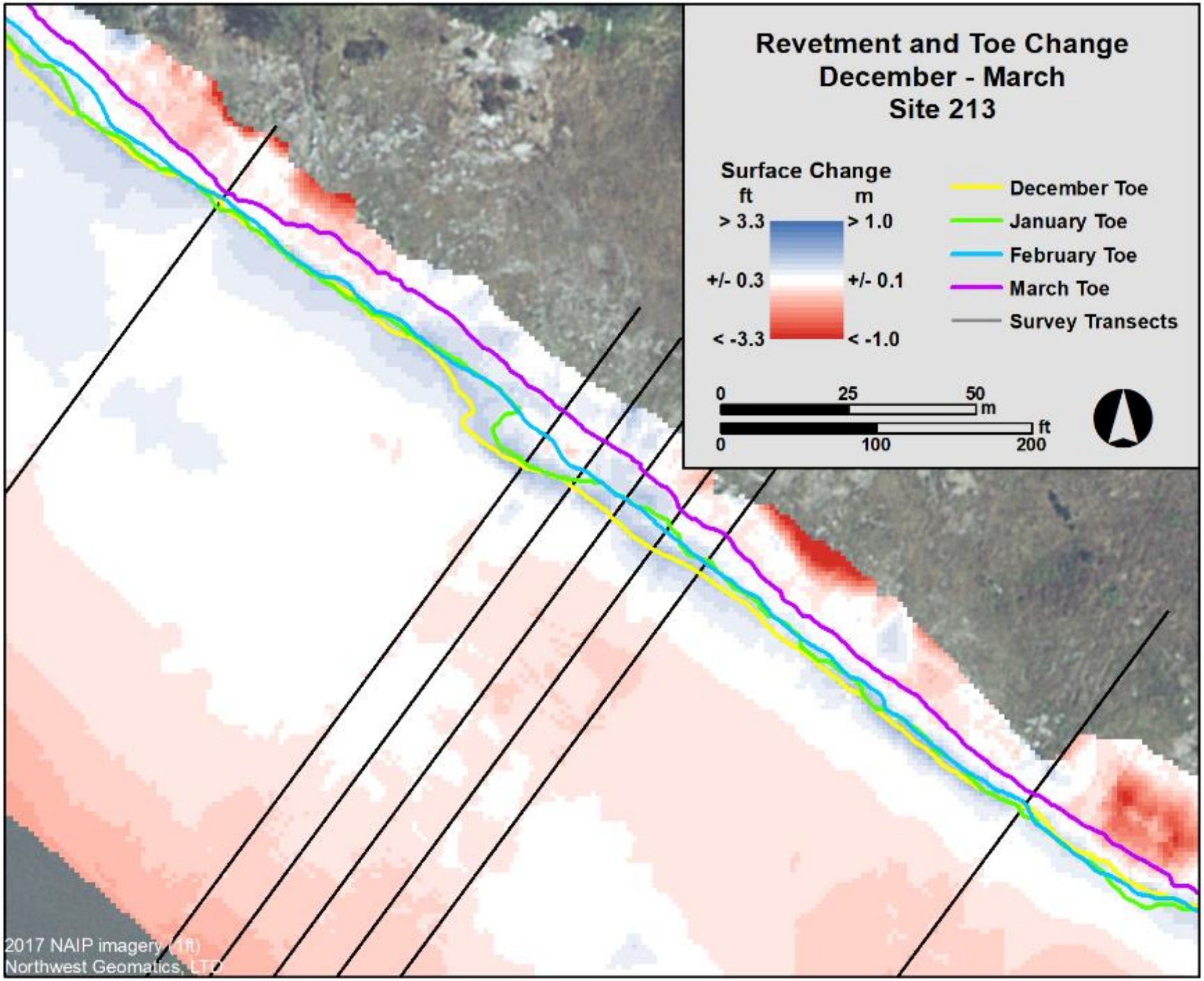
Photos courtesy of David Cottrell

North Cove – January 18, 2018 storm


Site 216
2/20/2019


2017 NAIP imagery (1ft)
Northwest Geomatics, LTD
Revetment and Toe Change
December - March
Site 216
Surface Change
ft
m
> 3.3
> 1.0
+/- 0.3
+/- 0.1
< -3.3
< -1.0
December Toe
January Toe
February Toe
March Toe
Survey Transects
0
25
50
m
0
100
200
ft


December 21, 2019


Revetment and Toe Change
December - March
Site 213
Surface Change
ft
m
> 3.3
> 1.0
+/- 0.3
+/- 0.1
< -3.3
< -1.0
December Toe
January Toe
February Toe
March Toe
Survey Transects
0
25
50
m
0
100
200
ft
2017 NAIP imagery (1ft)
Northwest Geomatics, LTD


December 21, 2019

January 23, 2019

January 28, 2019

January 17, 2019

January 21, 2019

January 23, 2019

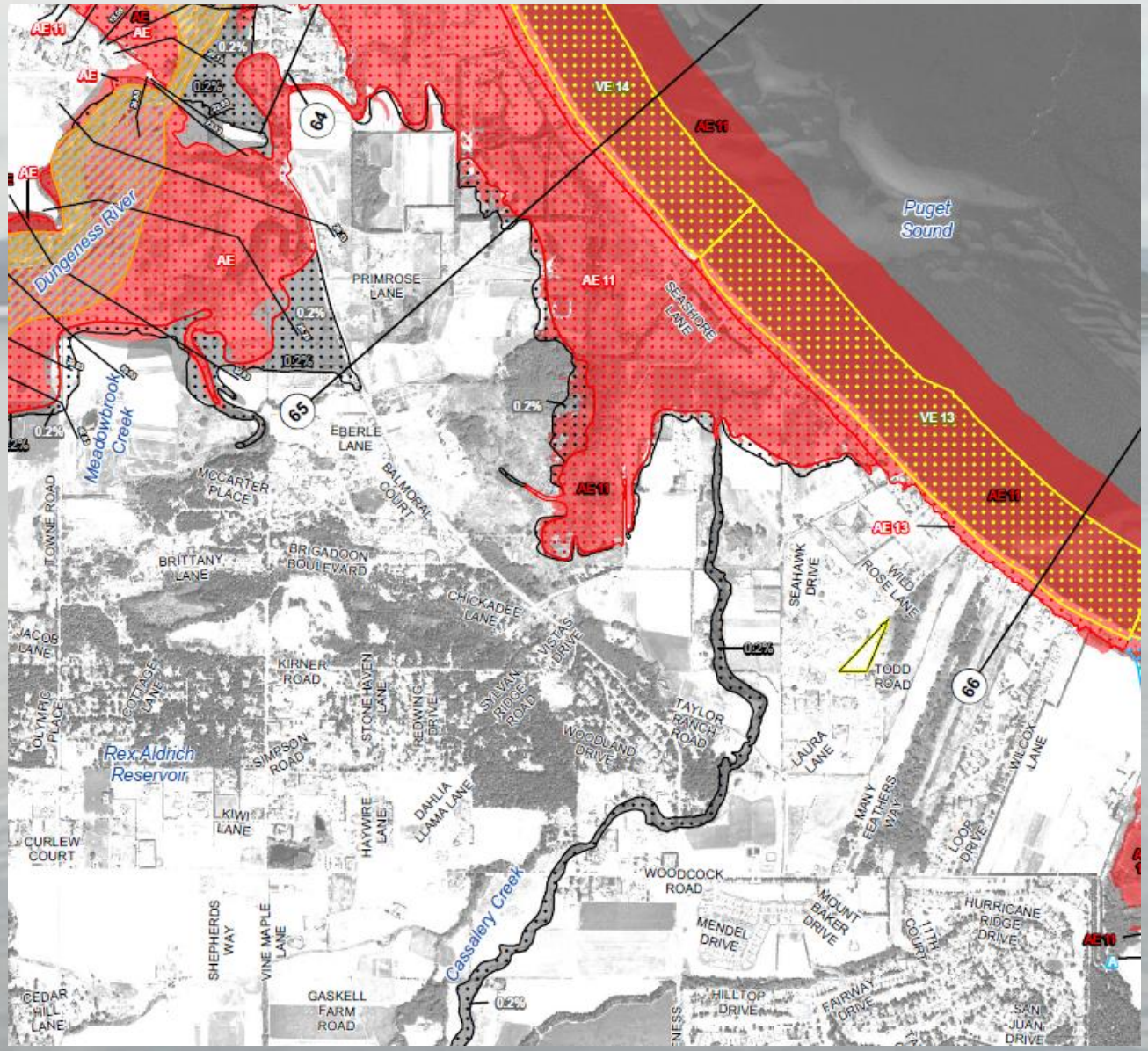

January 24, 2019
2019/01/24

January 25, 2019

January 28, 2019

Low and Wet: Coastal Flooding Adaptation Efforts at the Dungeness River Delta

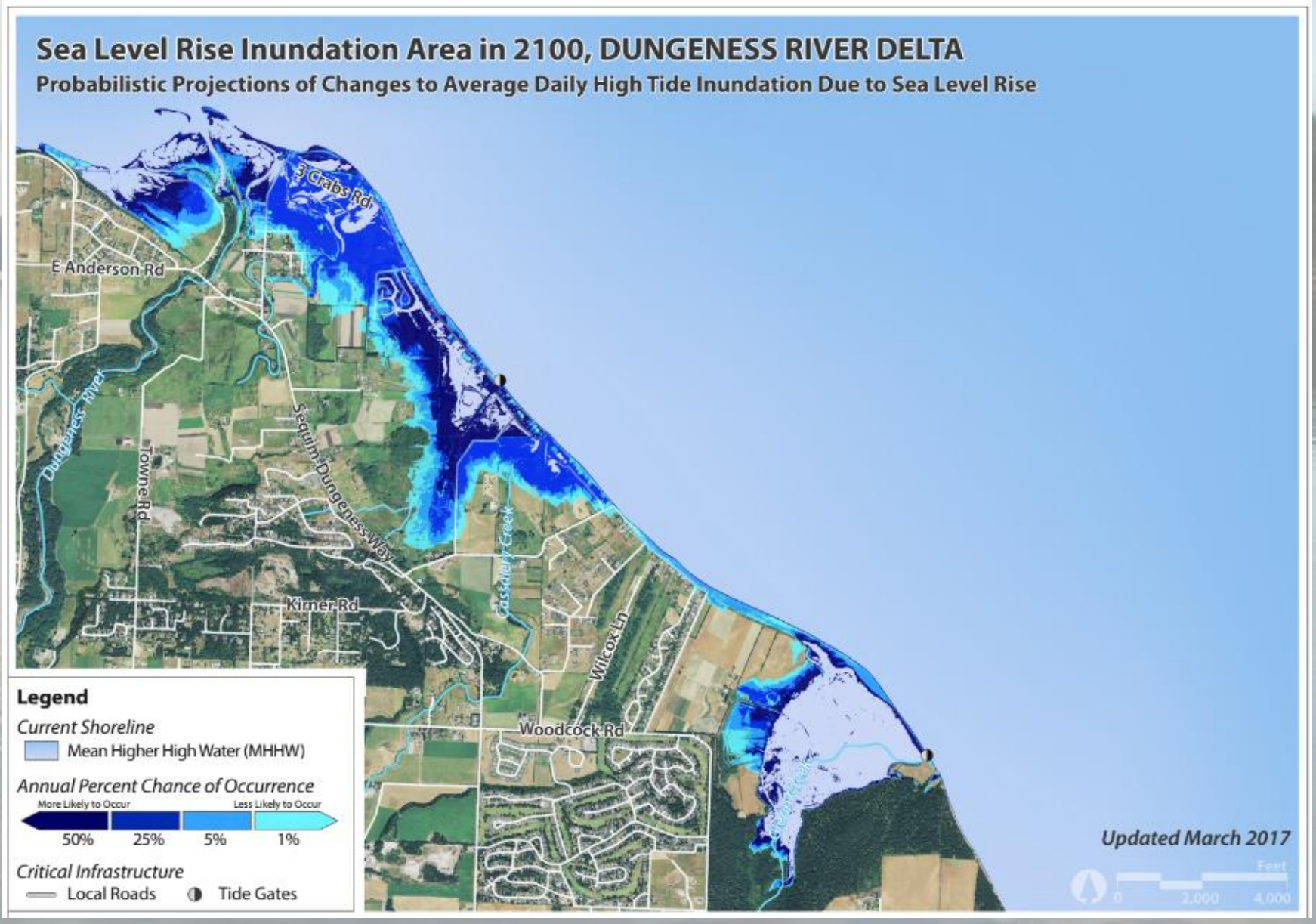
Background – why here?



Existing Flood Hazard

December 20, 2018

Background – why here?



Future Coastal Flood Hazard

Background – why here?

Contemporary habitat degradation in an important habitat zone, due to armoring and septics…that may get worse

Multiple Entity Group convenes

2013: JSKT develops climate change plan. Dungeness delta pops

2015: UW PoE students complete a communications toolkit for landowners

2016: Hansi Hals convenes a working group to start to work on next steps for landowner outreach

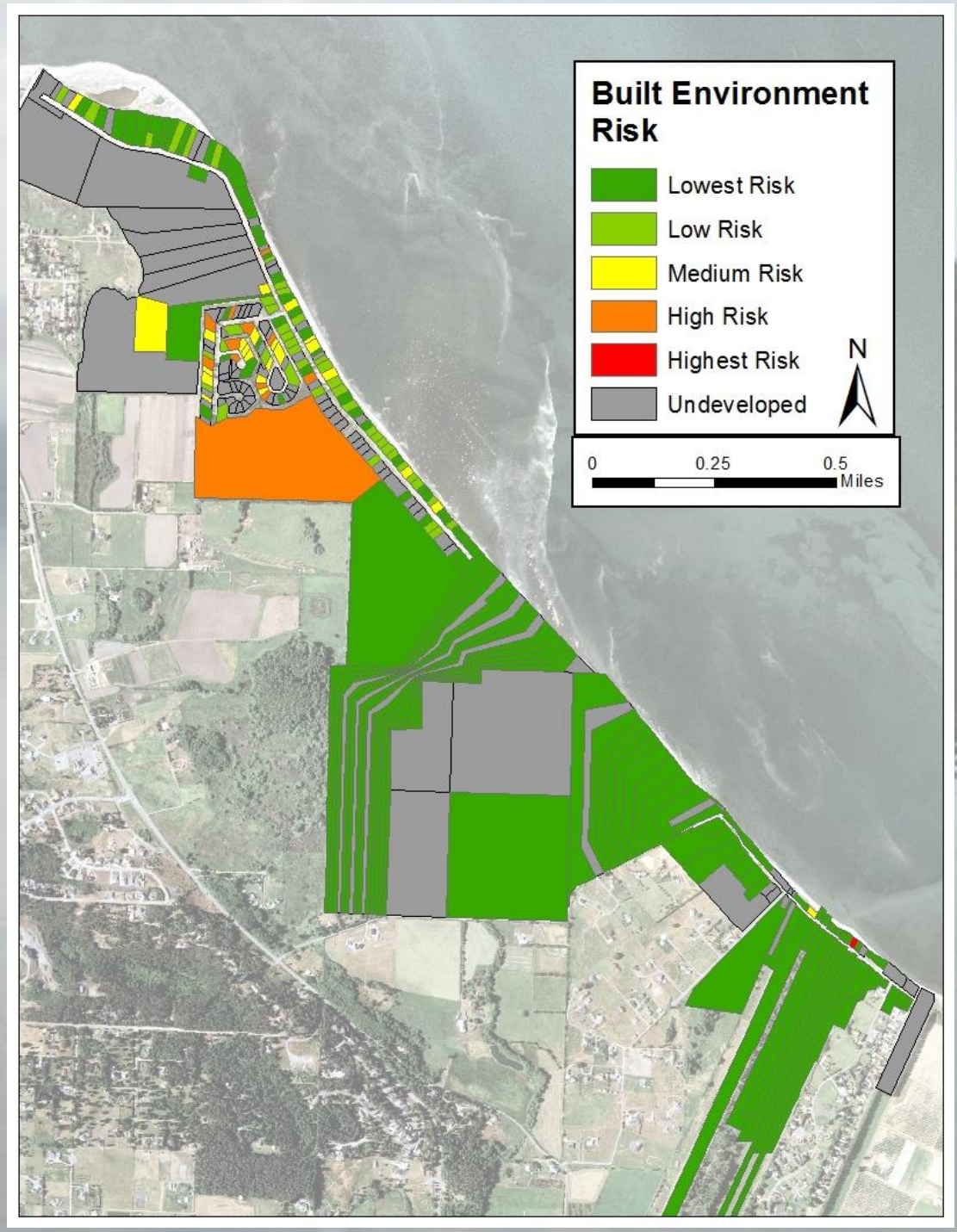
Attendees, talking ~ 2x per year

- JSKT
- Washington Department of Ecology
- Clallam County Community Development
- Clallam Conservation District
- WSU Extension
- Local Consultants
- Large landowners (i.e. Duck Club)
- Elected officials
- North Olympic Land Trust and other Non-profits
- North Olympic Salmon Coalition
- Clallam County Health
- Lead Entity for Salmon
- Strait Local Integrating Organization (PSP)
- Washington Sea Grant

Initial Steps:

Built Environment Risk

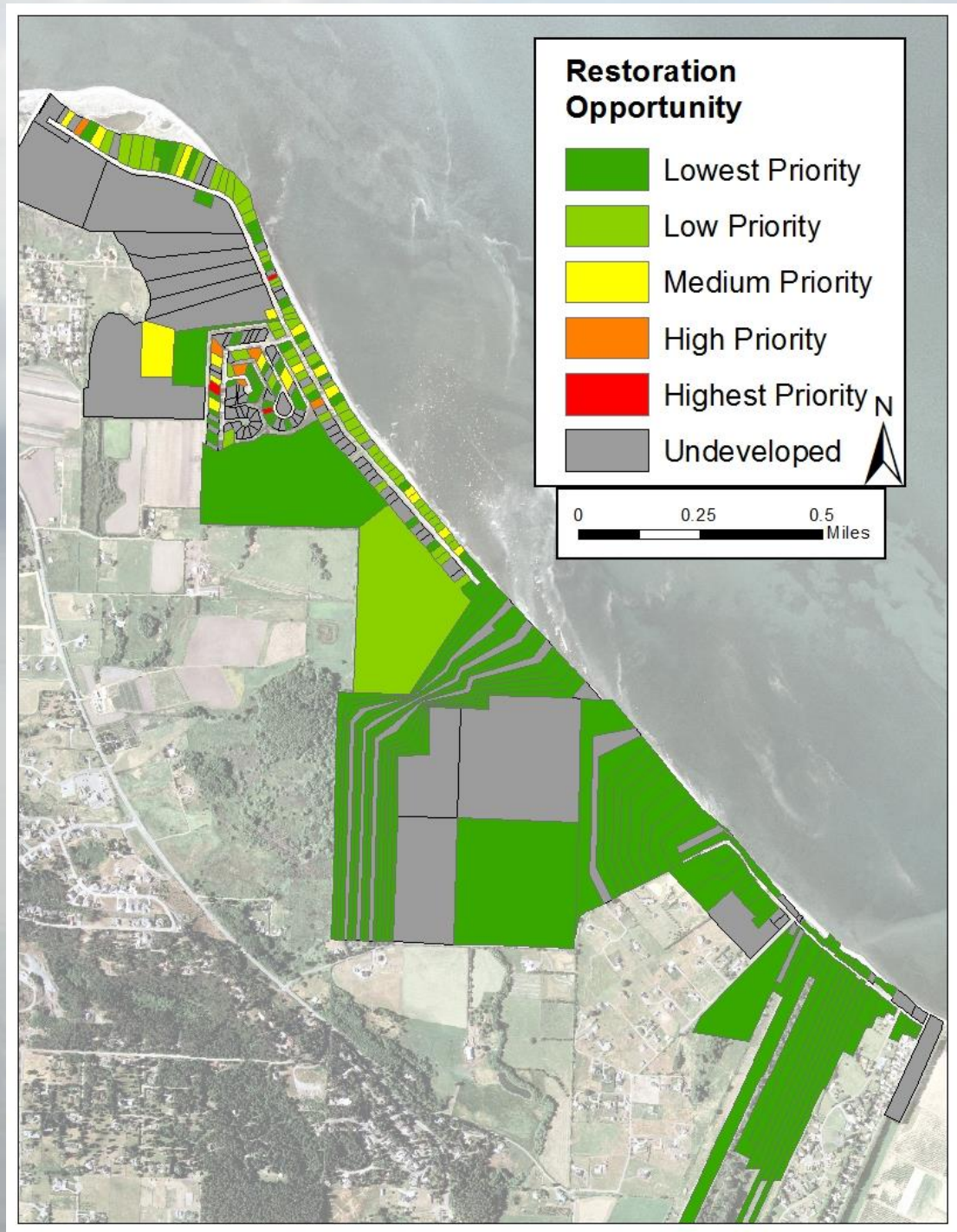
Built Environment Risk = (Exposure + BEV)/Adaptive Capacity



Initial Steps:

Restoration Opportunity

Restoration Opportunity= Ecosystem Sensitivity/Adaptive Capacity



Overall Prioritization

Outreach Opportunity Score = Built Environment Risk + Restoration Opportunity

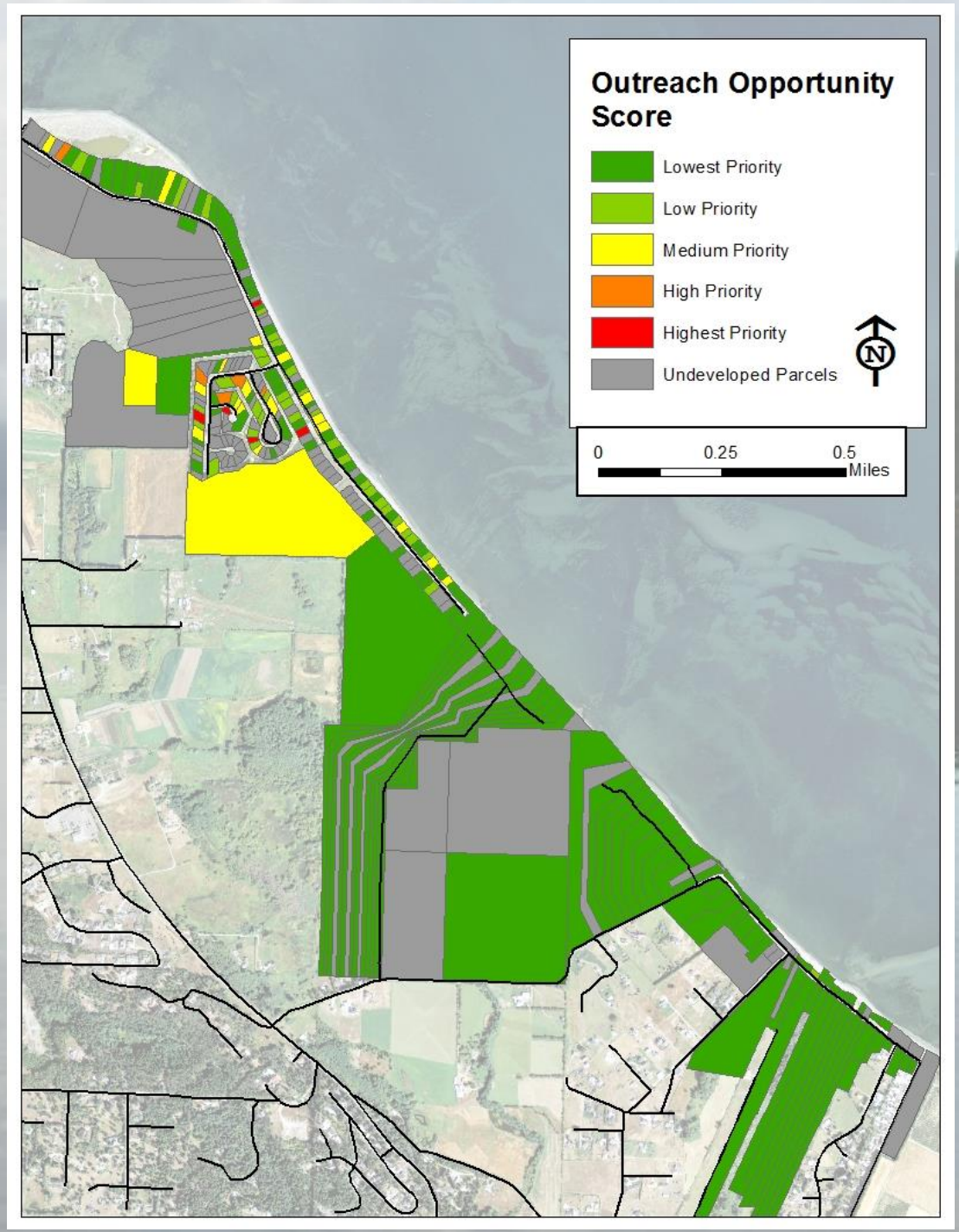
Where

*Built Environment Risk = (Exposure * Built Environment Vulnerability)/ Adaptive Capacity*

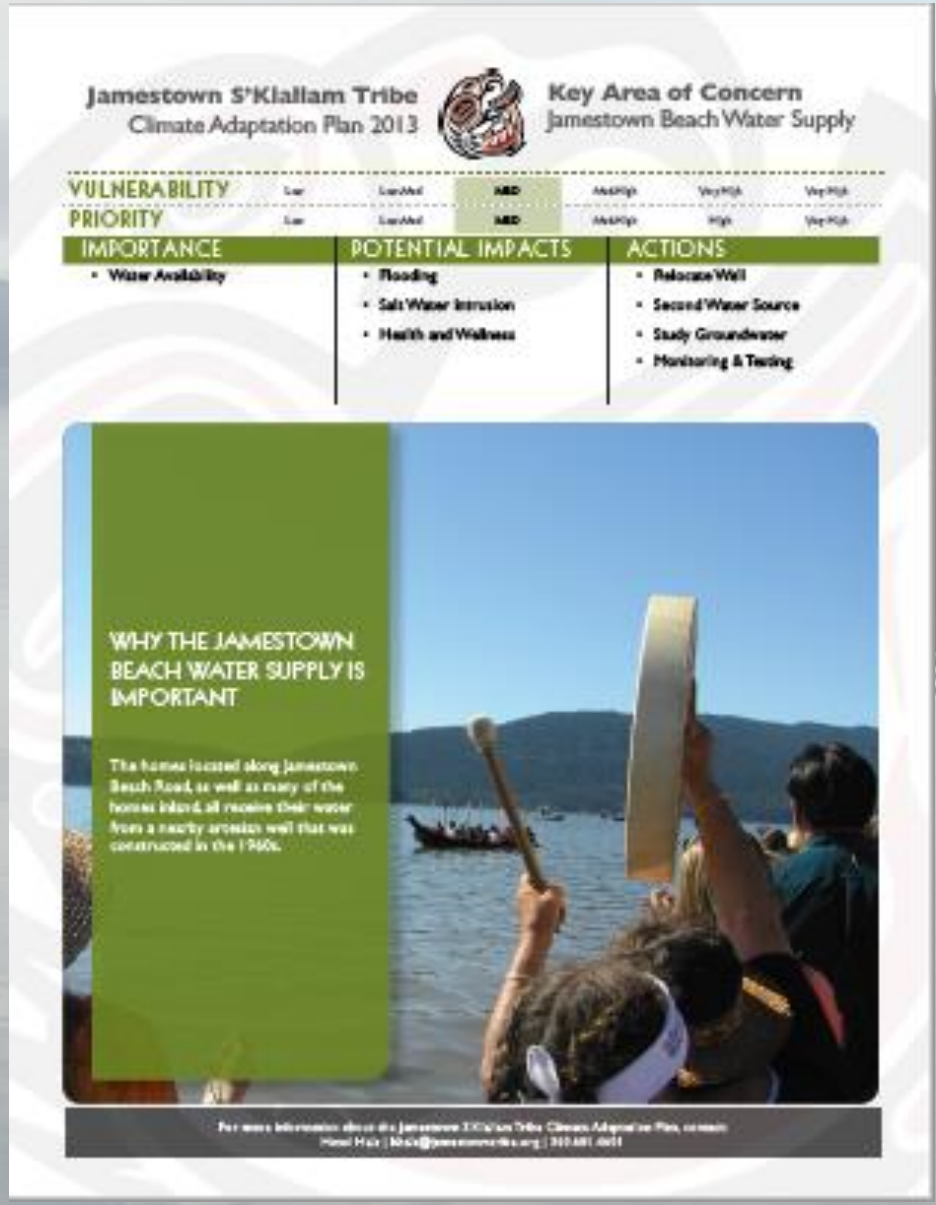
And

Restoration Opportunity= Ecosystem Sensitivity/Adaptive Capacity

**note bias in here that we need to work out relative to home value…*



We've also got tools:



Missing Pieces

$

The “right” event or evidence

Thank you!

Addressing coastal hazards through the NC Coastal Zone Management Program

June 5, 2019

Coastal Management

ENVIRONMENTAL QUALITY

North Carolina's Coast

320 miles of ocean beaches

10,000+ miles of estuarine shoreline

2.3 million acres of sounds, creeks, and marshes

Coastal tourism generates ~ $3B in annual revenue and supports ~35,000 jobs

Commercial and recreational fishing contribute ~$2B

Significant National Seashores, Wildlife Refuges, and other Federal, State, and local protected areas

NC Coastal Area Management Act (1974)

- **Balances competing coastal pressures** through development permitting and creation of a Coastal Resources Commission
- Addresses coastal growth and related issues through **local/state partnership**
- Conserves undeveloped land for education and research through a **Coastal Reserve Program**
- **Enhances public access** to beaches and coastal waters through grants to local governments

Division of Coastal Management - Sections

Regulatory Program

- 4 District Offices; Local Permitting Officers

Policy and Planning

- Policy development
- CAMA Land Use Planning
- Waterfront Access Grants
- Clean Marina Program

Coastal Reserve Program

- 10 Coastal Reserves
- Focus on research and education

NC Coastal Resources Commission

- Since 1974, **establishes policies and rules** under the CAMA and the NC Dredge & Fill Act
- **13 members** appointed by the Governor, Senate, House
- Membership includes **local gov't, fishing, science, agriculture, coastal land development** experience
- Designates "**Areas of Environmental Concern**" and related rules & policies

NC CRC Science Panel on Coastal Hazards

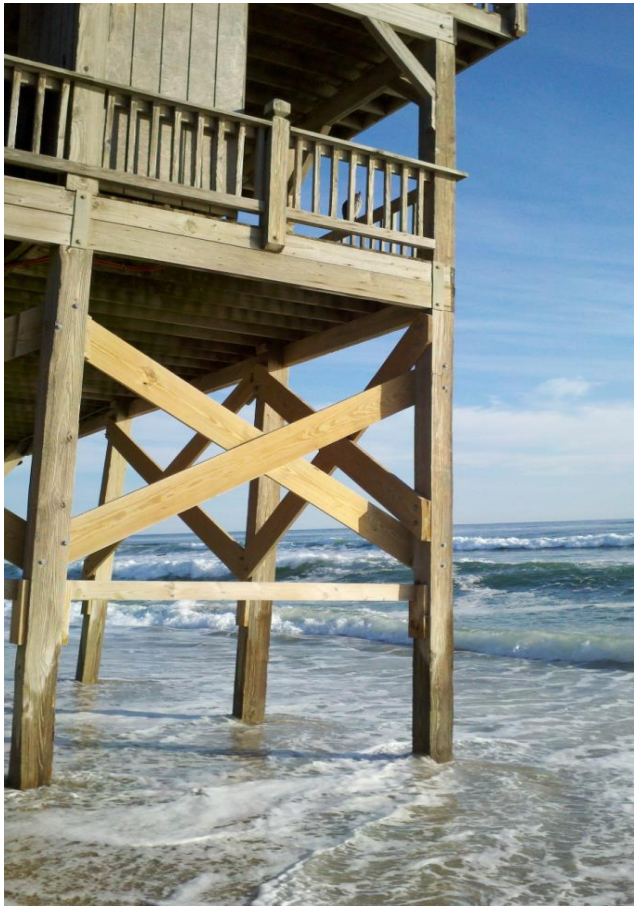
- **10 coastal geologists & engineers**
- **Scientific input for CRC policy development:**
  - Calculating long-term beach erosion rates
  - Establishing sediment criteria for beach nourishment
  - Delineating Inlet Hazard Areas
  - Monitoring and analysis of groin effects
  - Synthesizing information sea level rise
    - RSLR projections by region, from ~2 to ~8 inches in next 30 years

Coastal Storms

- **Hurricanes of the 1990's**
  - *Bertha*, *Fran*, *Bonnie*, *Dennis*, *Floyd*
- **Hurricane Floyd (1999)**
  - Heavy rains, 10 ft. storm surge; ~$8B
- **Hurricane Isabel (2003)**
  - 2000' wide inlet on Hatteras Island
- **Hurricane Matthew (2016)**
  - ~12 inches of rain, $4.8B damages
- **Hurricane Florence (2018)**
  - **20-34 inches of rain**, up to 13 ft surge
  - **$17B disaster**

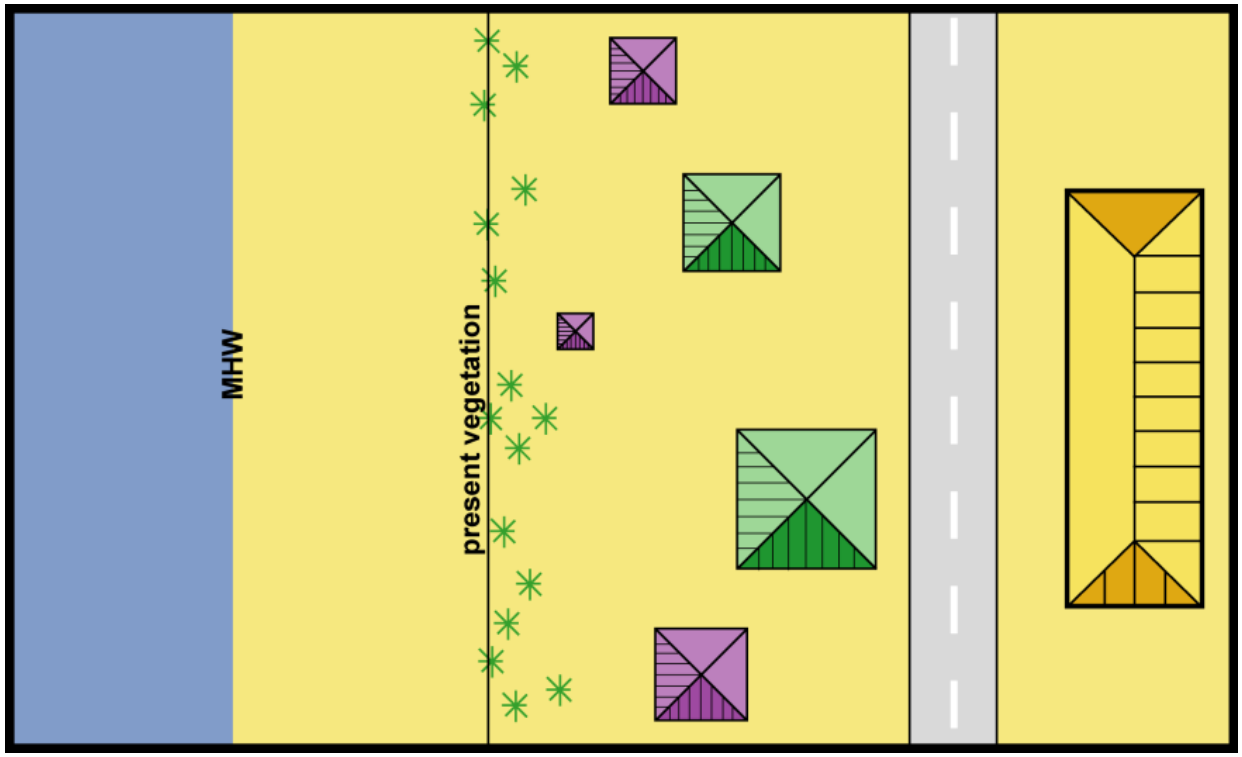
Oceanfront Shorelines

- **DCM jurisdiction includes:**
  - *Ocean Erodible Areas*
  - *Inlet Hazard Areas*
- **Erosion rate-based setbacks** based on size of structures
- **Ban on permanent erosion control structures**
- **Rules governing beach and inlet projects**

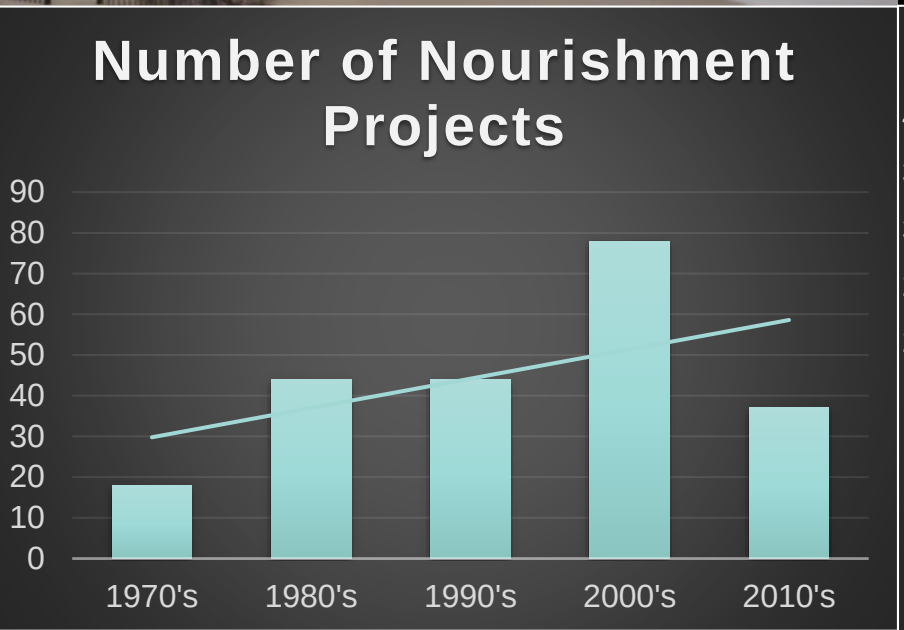


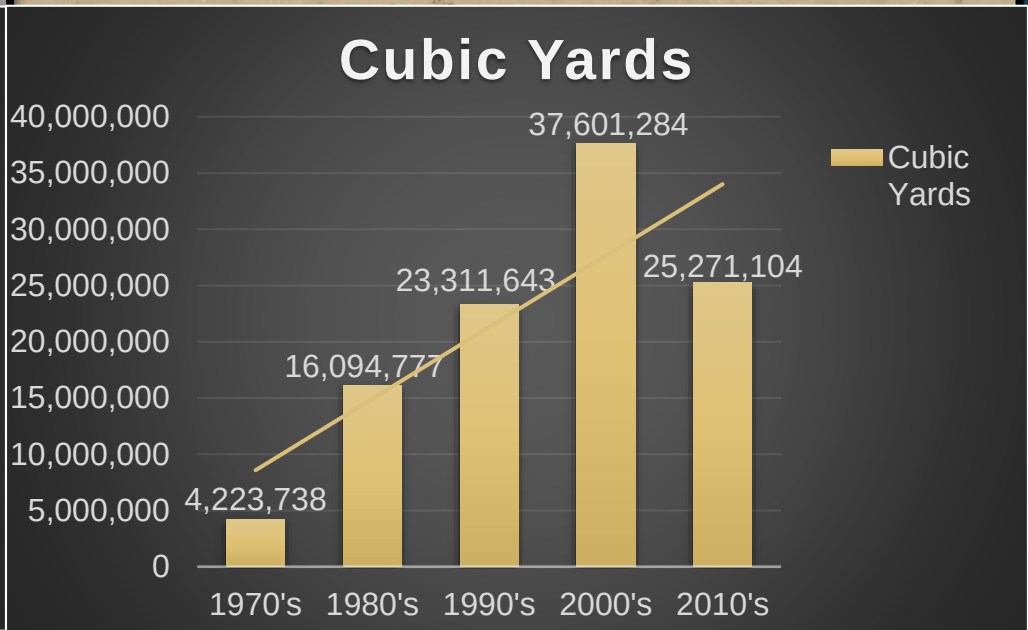
Graduated Construction Setbacks

- **Graduated, erosion-based setbacks based on size of structures and local long-term erosion rates**
  - Minimum setback = 60 ft
  - < 5000 sf… x30
  - 5-10K sf… x60
  - 10-20K sf.. x65
  - 20-40K sf.. x70
  - 40-60K sf.. x75
  - 60-80K sf.. x80
  - 80-100Ksf.. x85
  - Over 100K.. x90



Increasing Role of Beach Nourishment



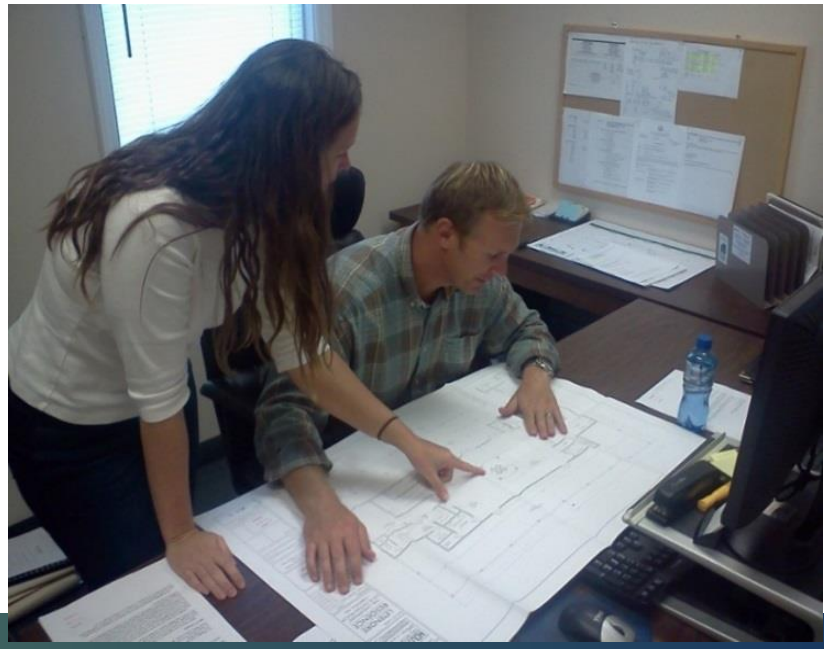


Estuarine Shorelines

- **Estuarine Shoreline Area of Environmental Concern**
  - 30 ft shoreline buffer for non-water dependent structures
  - Limitation on impervious surfaces within 75 ft
- **DCM focused on promoting "Living Shorelines"**
  - Streamlined permitting and demonstration projects
  - Funding, technical assistance and outreach

Coastal Resilience Initiatives

- **Governor Cooper's Executive Order 80**
  - Requires state climate risk assessment and resiliency plan
  - Directs agencies to support local resilience planning
- **Offering Local Resilience Planning Grants**
  - Over past 2 years, funded ~15 projects up to $25K
- **Providing Technical Assistance**
  - Partnering w/ NC TNC and NC Sea Grant to support community planning efforts



Questions?

www.nccoastalmanagement.net & join CAMAgram!

Addressing coastal hazards along the California coast through planning and permitting

WA's Coastal Hazards Resilience Network meeting
June 5, 2019

Mary Matella, PhD, Environmental Scientist
California Coastal Commission

CALIFORNIA
COASTAL
COMMISSION

Today

Coastal Hazards

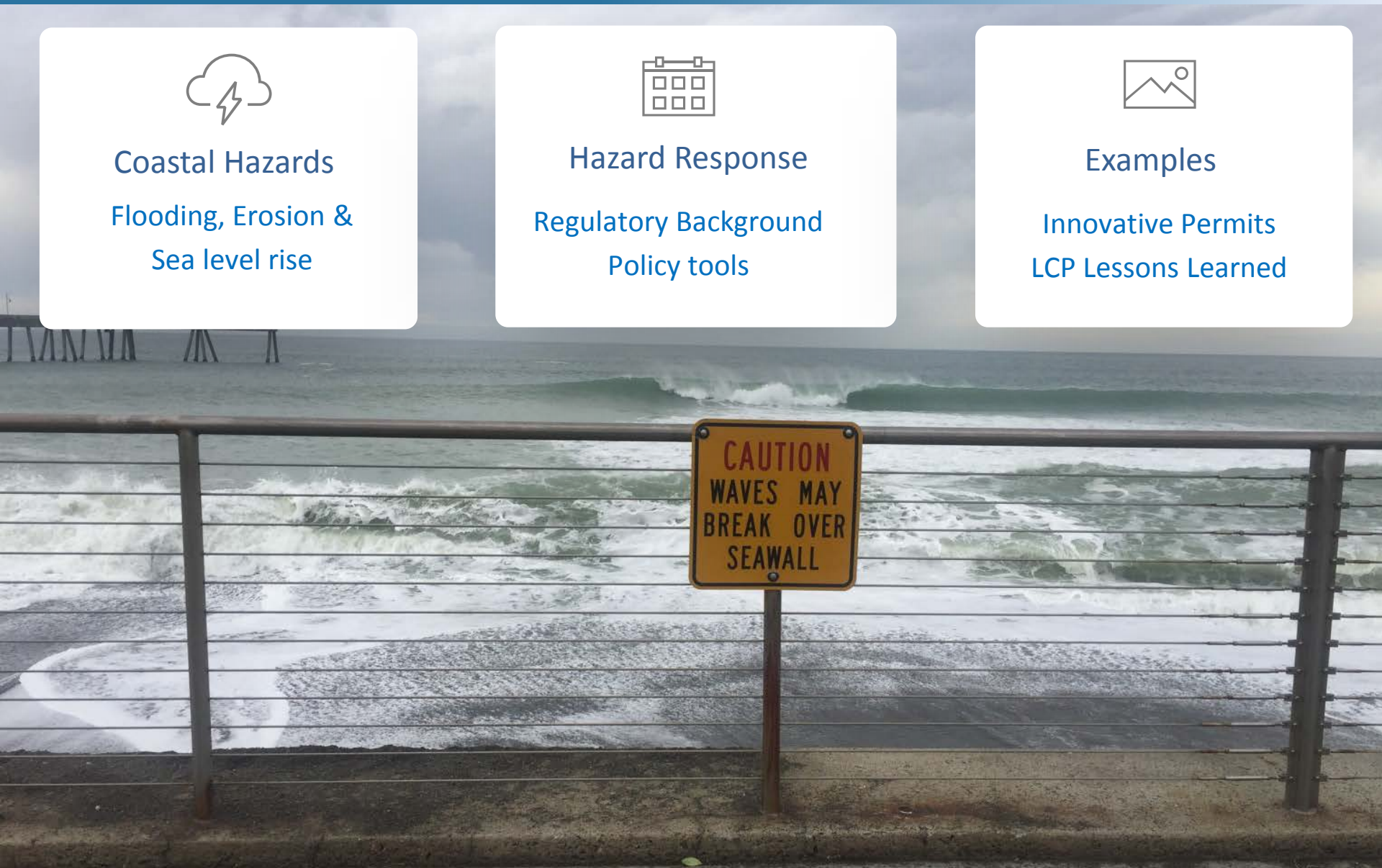
Flooding, Erosion &
Sea level rise

Hazard Response

Regulatory Background
Policy tools

Examples

Innovative Permits
LCP Lessons Learned



Coastal Hazards

Pasture flooding near
Liscom Pasture, Arcata

Coastal Hazards

Coastal Hazards

Coastal Hazards

Bluff erosion at Lands End in Pacifica

Coastal Hazards

Bluff erosion at Lands End in Pacifica

Coastal Hazards

Coastal Hazards

Bluff erosion in Isla Vista

Coastal Hazards

California King Tides Initiative

Flooding at Ledbetter Beach, Santa Barbara

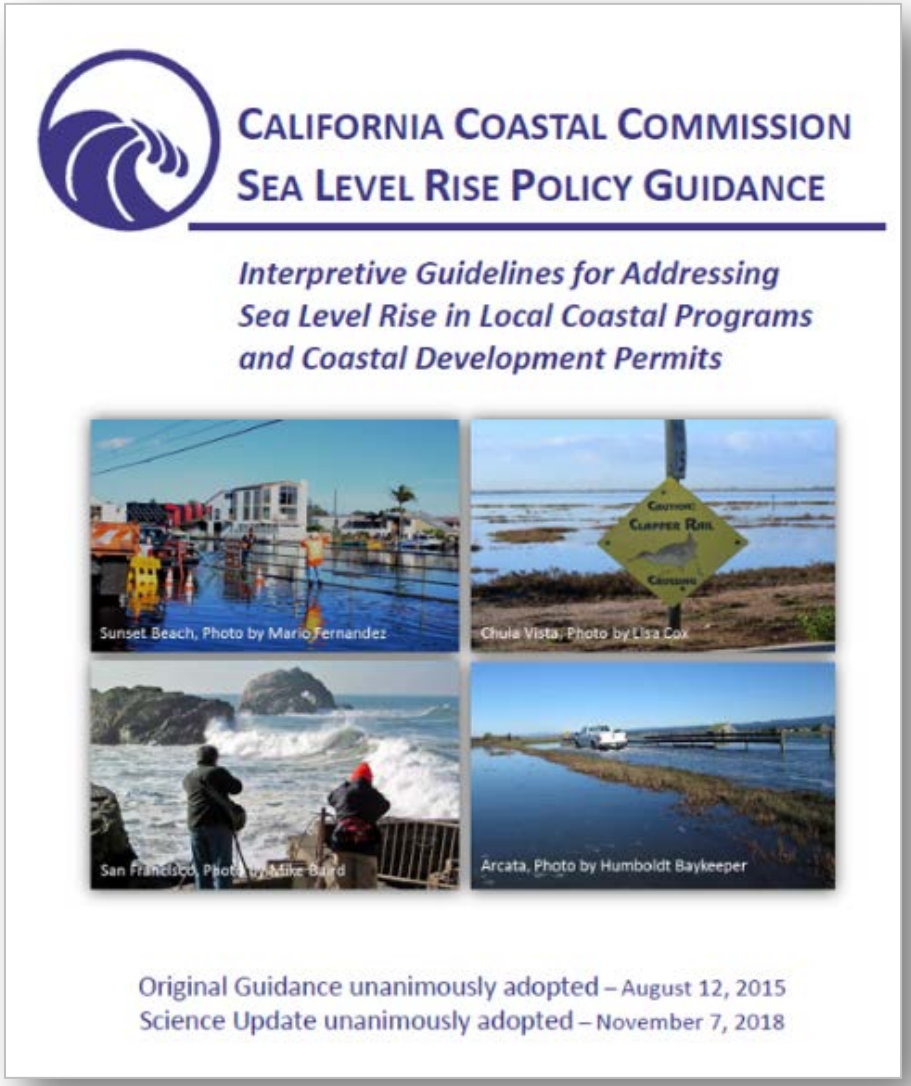
Coastal Hazards

Coastal Hazards

Addressing Coastal Hazards

Framework of Coastal Act Policies

Addressing Coastal Hazards & SLR



- Principles for Addressing SLR
- Use Best Available Science
- Analyze Planning Scenarios/Development Constraints
- Identify Adaptation Measures
- Design Projects to address hazards and protect coastal resources
- Update LCPs

Additional Coastal Adaptation Guidance

- Residential
- Critical Infrastructure

Coastal Act Implementation:
State & Local Partnership

- Coastal Development Permits (CDPs)
- Local Coastal Programs (LCPs)
  - Land Use Plan & Zoning Ordinance
  - Specify kinds, locations, and intensities of development

Santa Monica Beach
Photo Credit: Coastal Commission staff

California Coastal Trail, San Francisco
Photo Credit: Coastal Commission staff

Addressing Coastal Hazards & SLR

Phasing approaches, using CDPs and LCPs

Protect

Accommodate

Retreat

Natural solutions

Addressing Coastal Hazards & SLR

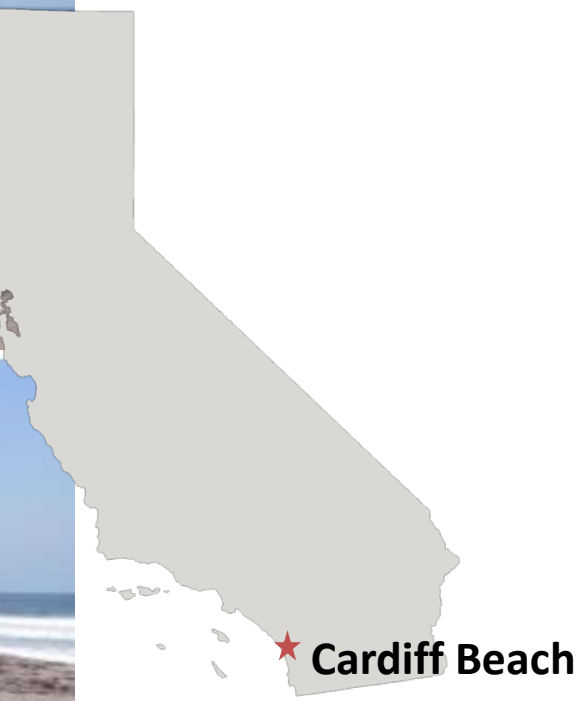
Policy Tools

- Setbacks/project design that incorporate SLR
- Hazard zoning overlays
- Restrictions on future armoring
- Deed restrictions/real estate disclosures
- Triggers for additional requirements in the future
- Committing to additional planning work

Cardiff Beach

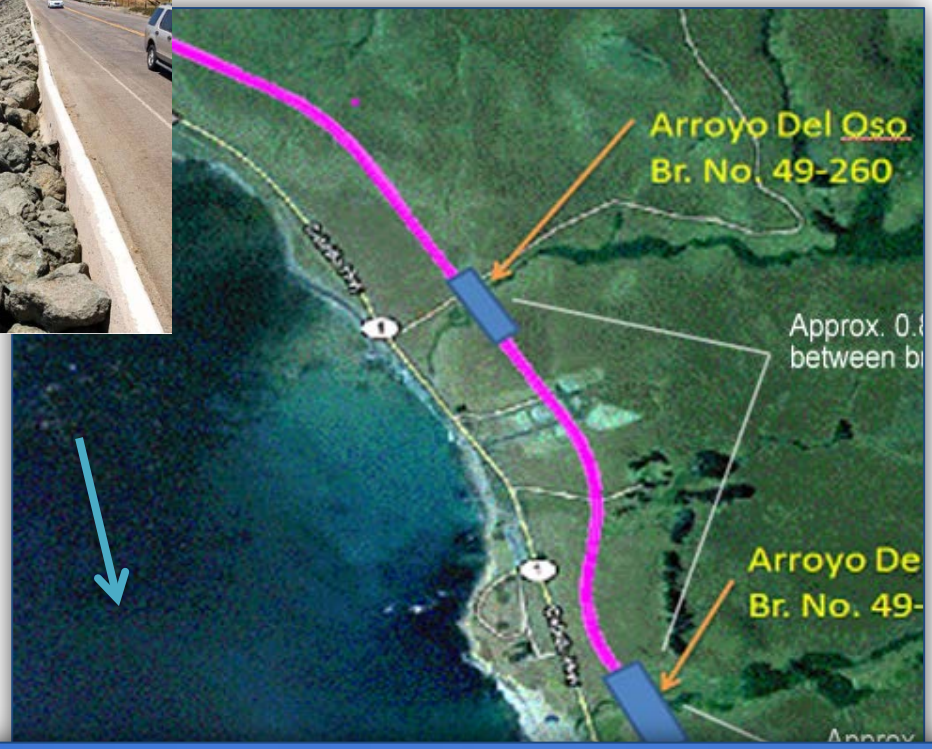
Cardiff State Beach Living Shoreline

Photo: Moffatt & Nichol dune simulation



Piedras Blancas

Caltrans Hwy 1 Realignment

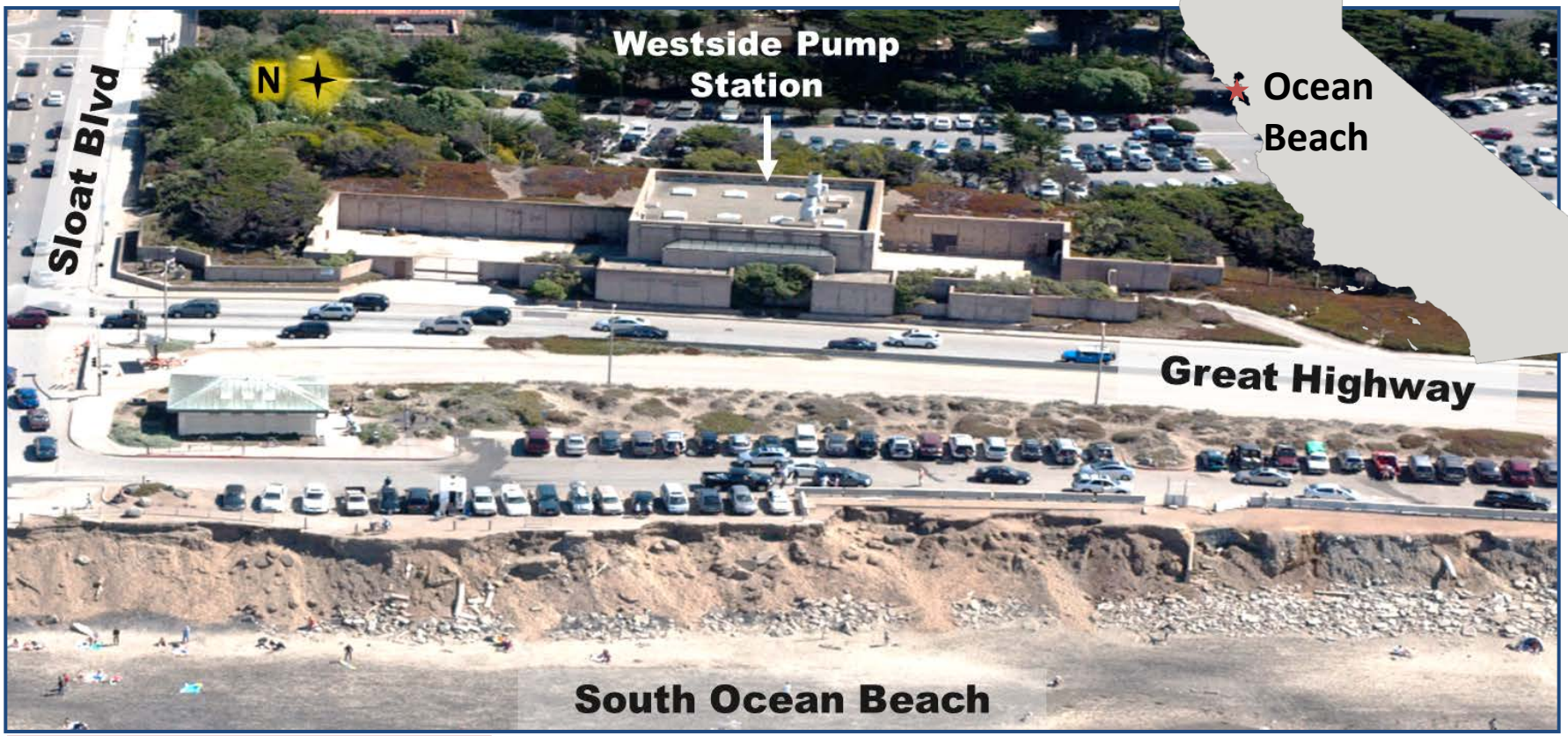


Piedras Blancas
Realignment
San Luis Obispo Co.

Ocean Beach

Erosion at Ocean Beach, SF

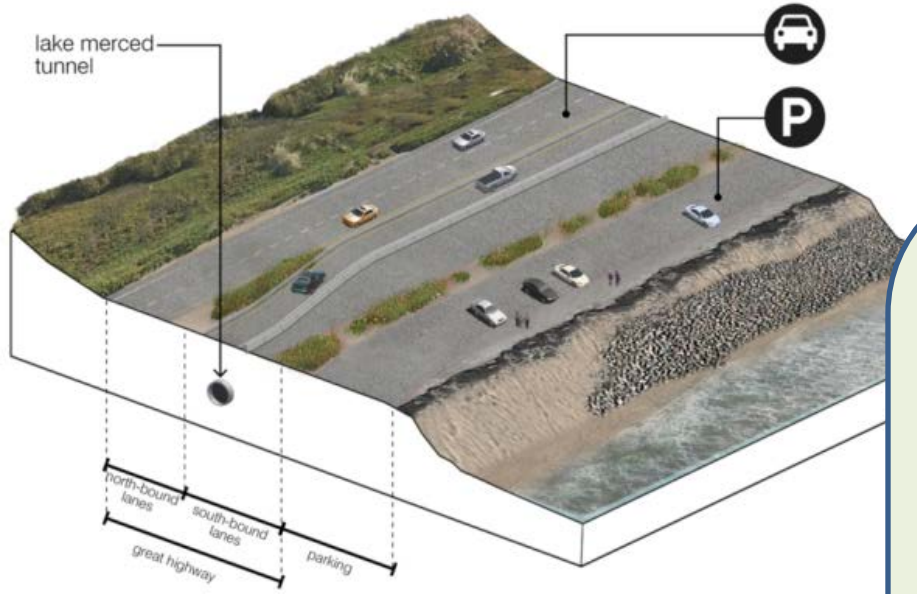
Coastal Development Permits



Great Highway,
South Ocean Beach
San Francisco

Temporary permit and conditions to allow short term protection while a long term plan is identified and implemented

Erosion at Ocean Beach, SF



Ocean Beach Master Plan

- Stakeholder driven process
- Remove lanes from Great Hwy., and eventually re-route
- Add bike, pedestrian trails
- Dune restoration
- Buried wall to protect wastewater infrastructure

✓ Local Coastal Program Amendment

- Policy development to implement Ocean Beach Master Plan

Photo credit: Ocean Beach Master Plan

Lessons Learned

- Context/Scale matters
  - Need willing landowners and partners
- Long timeframes necessary for larger project extents
- Acknowledge risk related to public trust resources
- Incentives for local governments to update policies

Lessons Learned

SLR Vulnerability Assessment → Adaptation Plan → LUP Updates → IP Updates → Local Adoption → CCC Certification

- Detail informs actionable policies
- Explain assumptions and limitations

- Outreach
- Education

- Separate adaptation stage
- Buy-in from stakeholders

- Start now
- Plan for updates
- Adaptive policies w triggers

Next Steps

Outreach

Guidance & Briefings

Funding

Local Assistance Grant Program

Model Language

Residential & Critical Infrastructure Adaptation

Coordination

Interagency projects

Thank you

https://www.coastal.ca.gov/climate/slr/
mary.matella@coastal.ca.gov

Scott's Creek
Santa Cruz County

Photo Credit: Lauren Garske-Garcia

HAWAII COASTAL ZONE MANAGEMENT PROGRAM:

ADDRESSING COASTAL HAZARDS

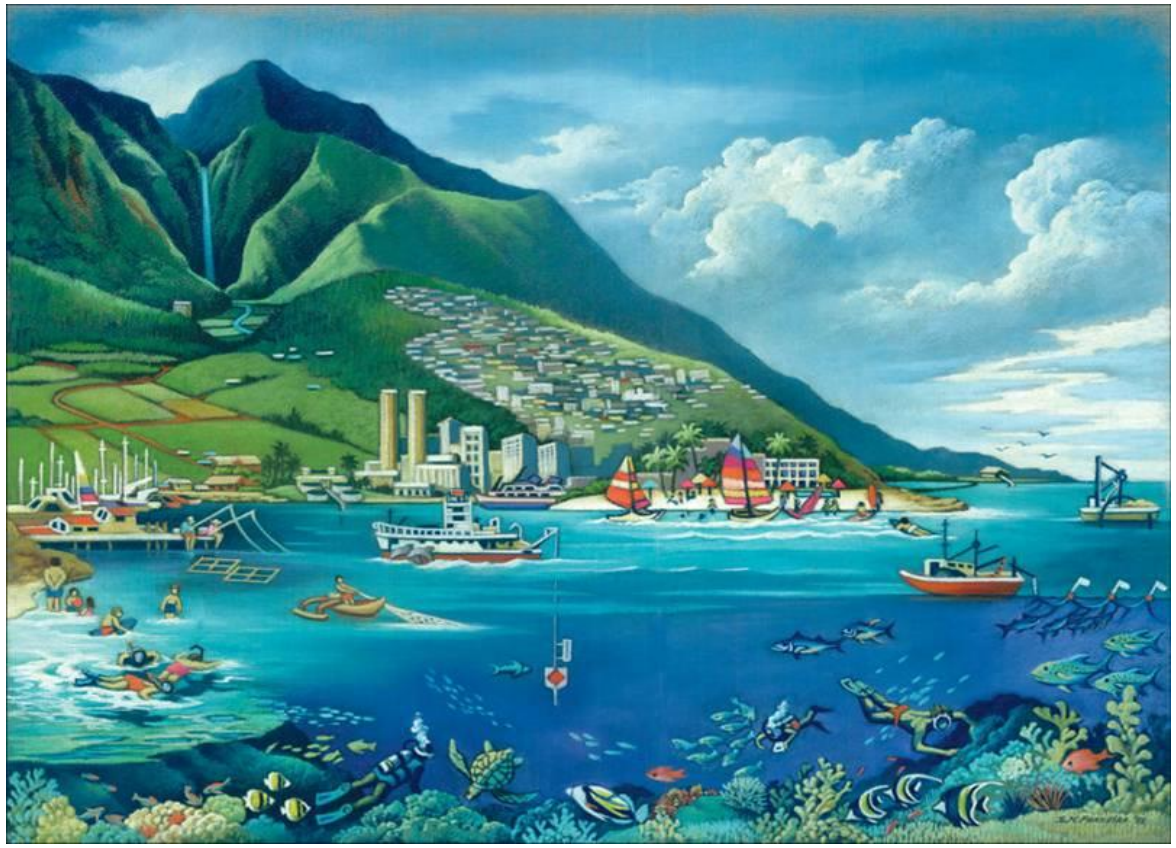
Washington Coastal Hazards Resilience Network
2019 Annual Meeting

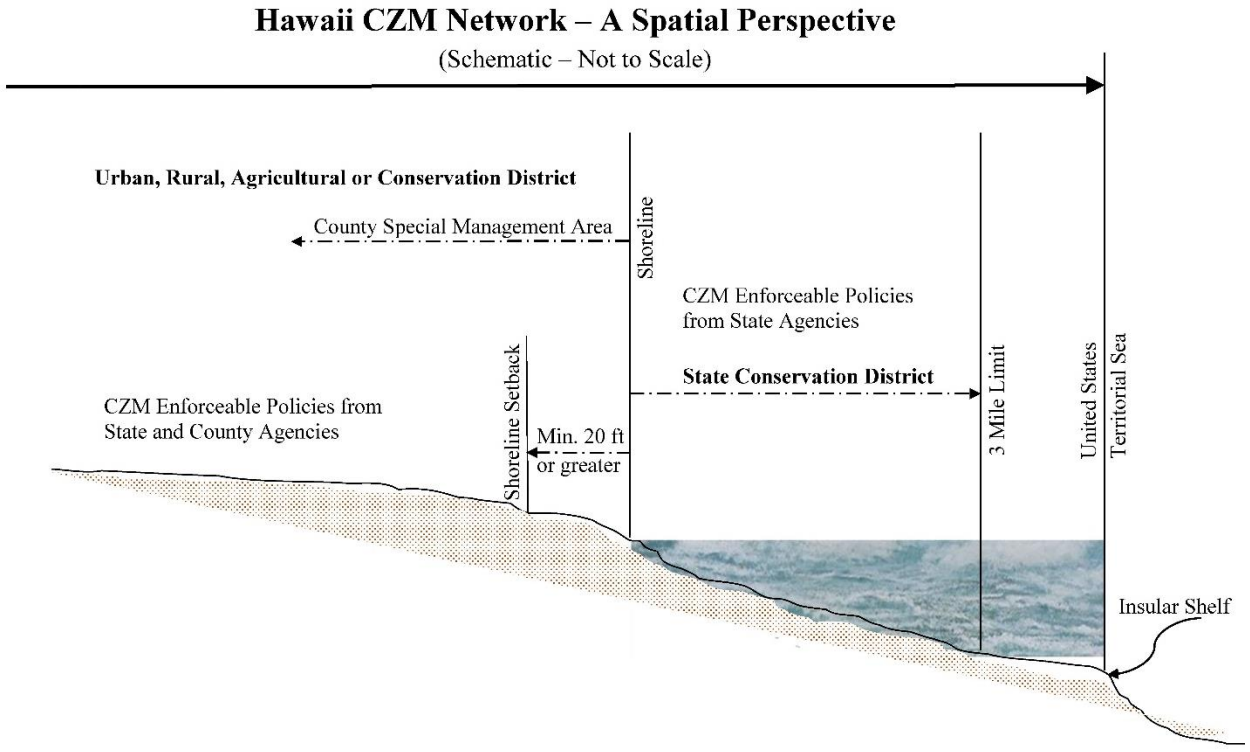
June 5, 2019

Hawaii CZM Program
Coastal Zone Management
HAWAII STATE OFFICE OF PLANNING

OVERVIEW OF THE COASTAL ZONE MANAGEMENT PROGRAM

Coastal Zone Management Area



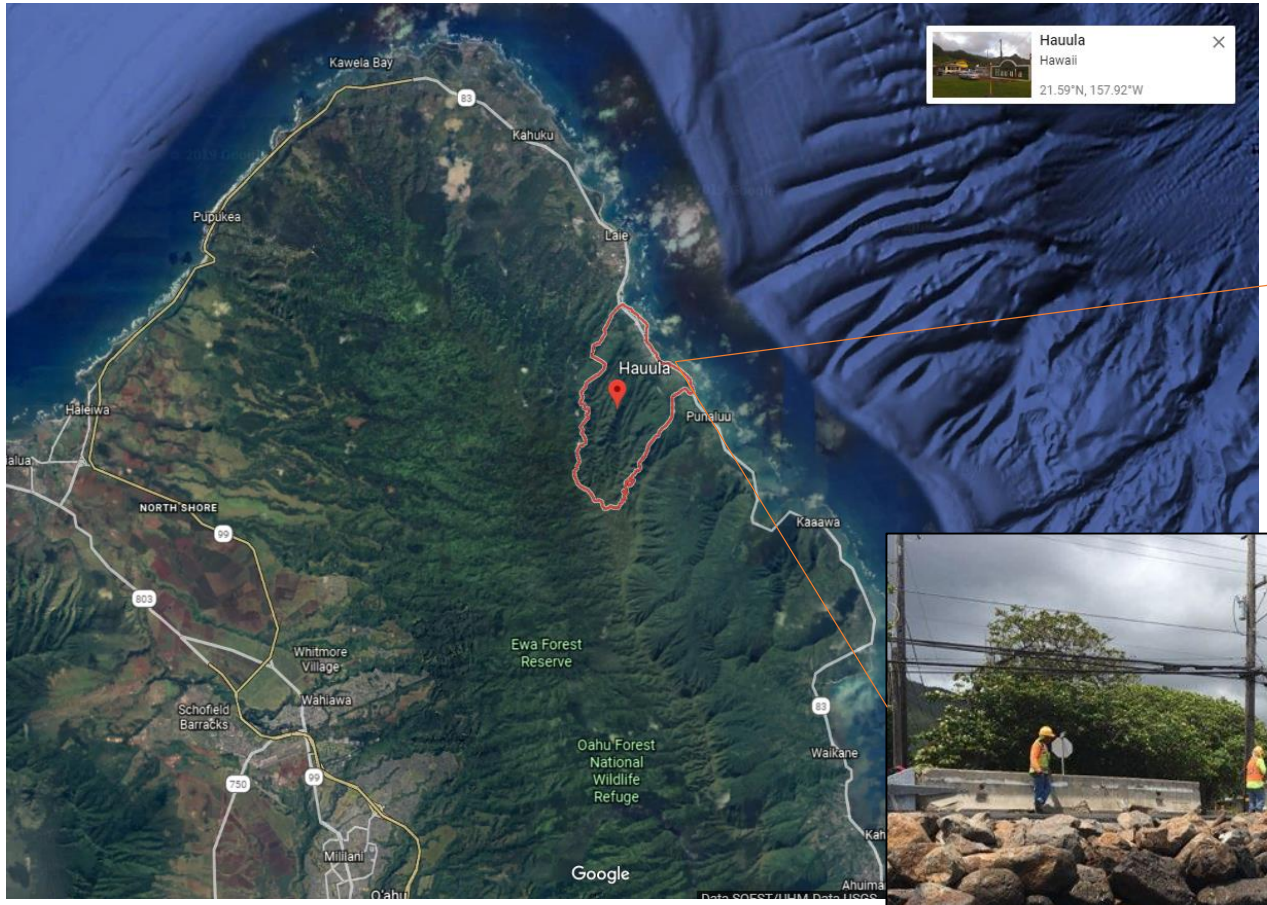


§205A-1 Definitions.

"Coastal zone management area" means all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the United States territorial sea;

"Lead agency" means the office of planning;

Coastal Erosion and Hazards



Source: Google Earth

Source: HDOT

Source: HDOT

Coastal Erosion and Hazards

Source: M. Lander

Source: S. Ma

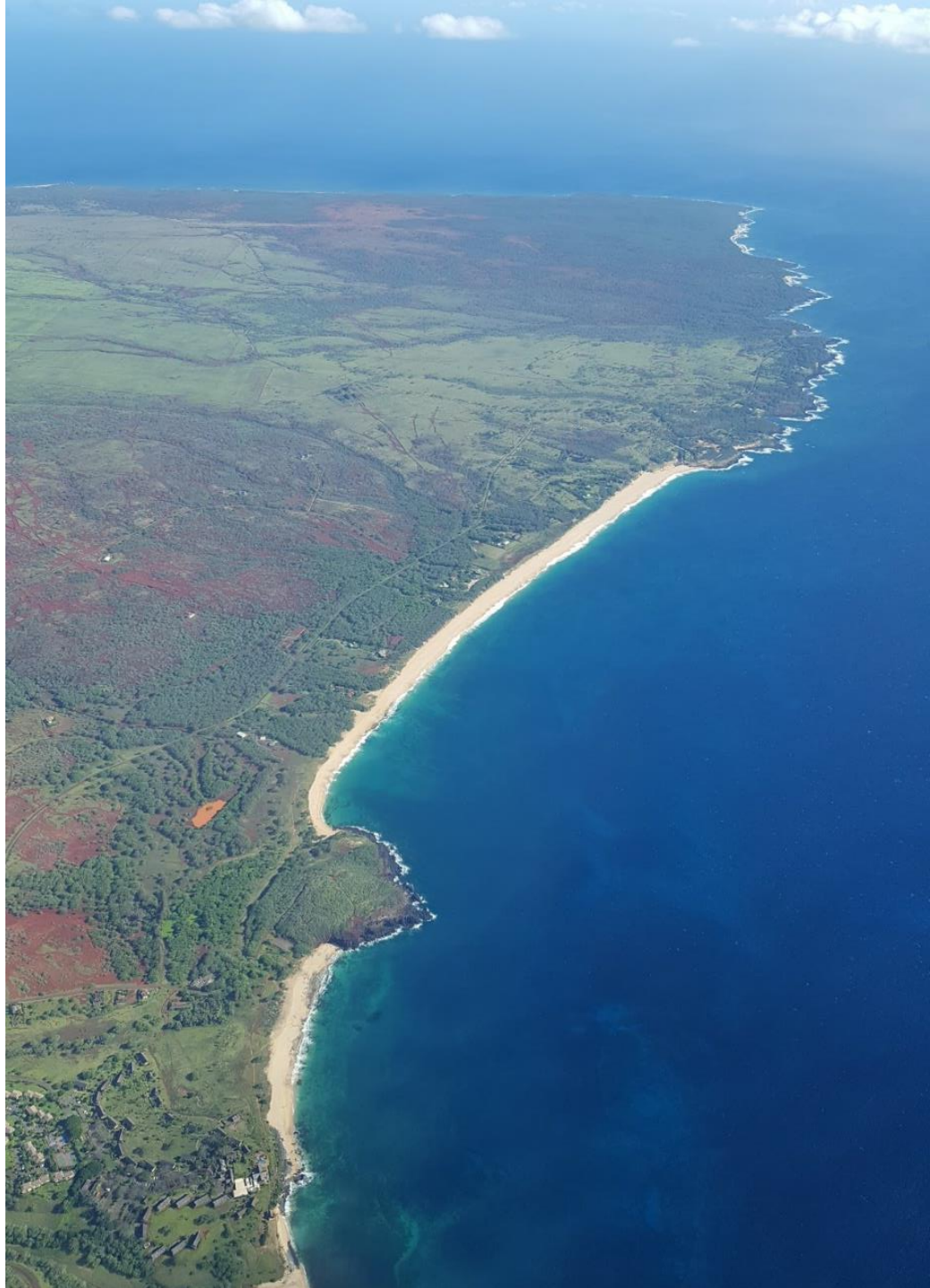
Coastal Erosion and Hazards

Source: Farmer Ray

Source: Google Earth

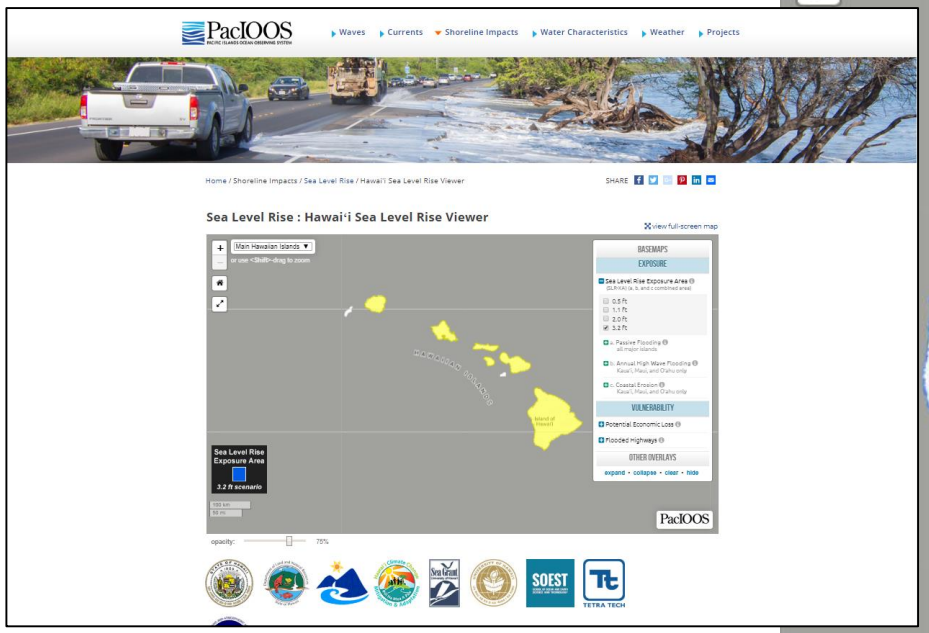
CZM Supported Projects

- Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai‘i
- Updating the Hawaii Historical Shoreline Database
- Development of Probabilistic Tsunami Design Zone Mapping
- Building Code Amendments for Coastal Hazards and Climate Change - Oahu

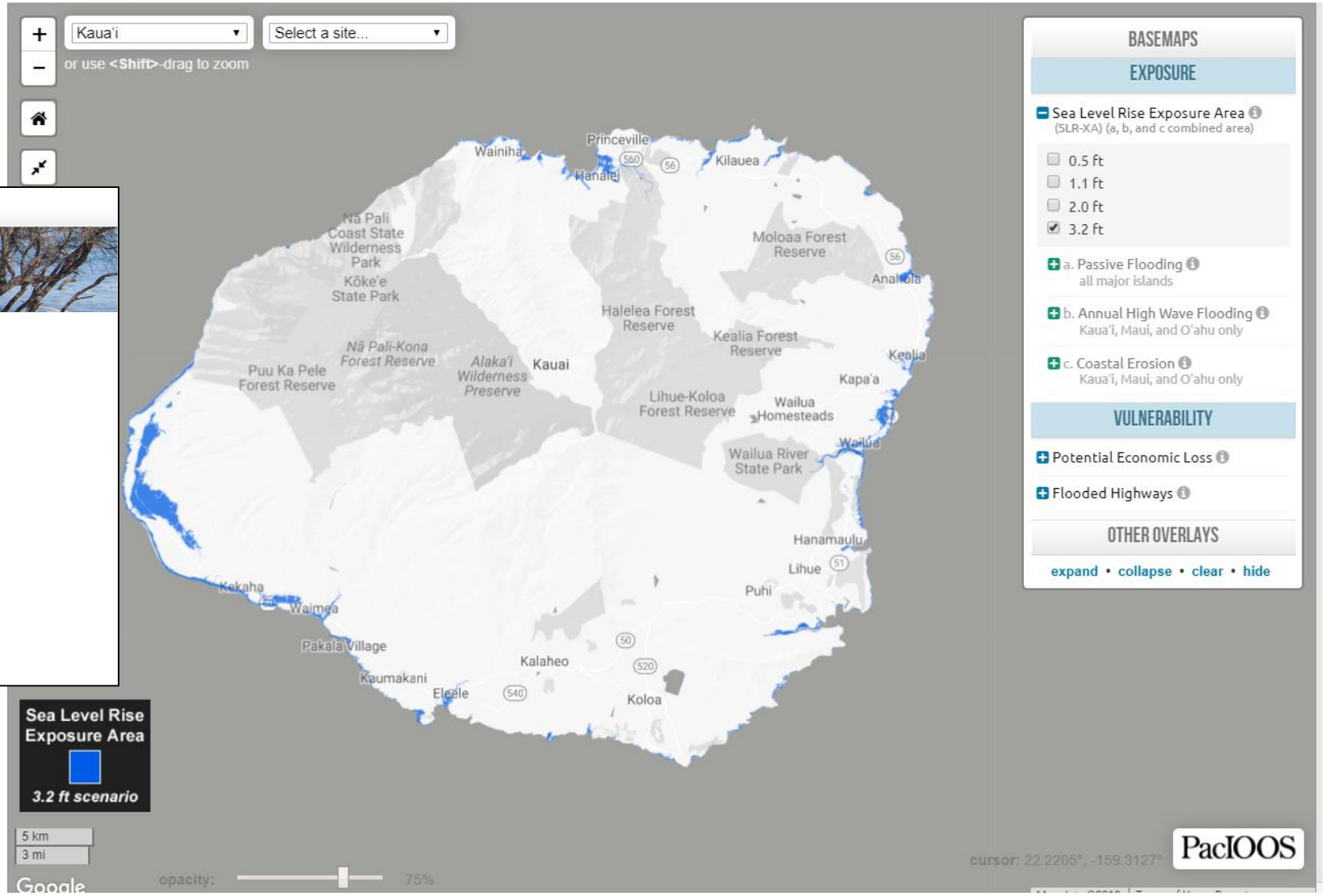


Hawaii CZM Program
Coastal Zone Management
HAWAII STATE OFFICE OF PLANNING

Hawai`i Sea Level Rise Viewer



Source: State of Hawaii and PacIOOS

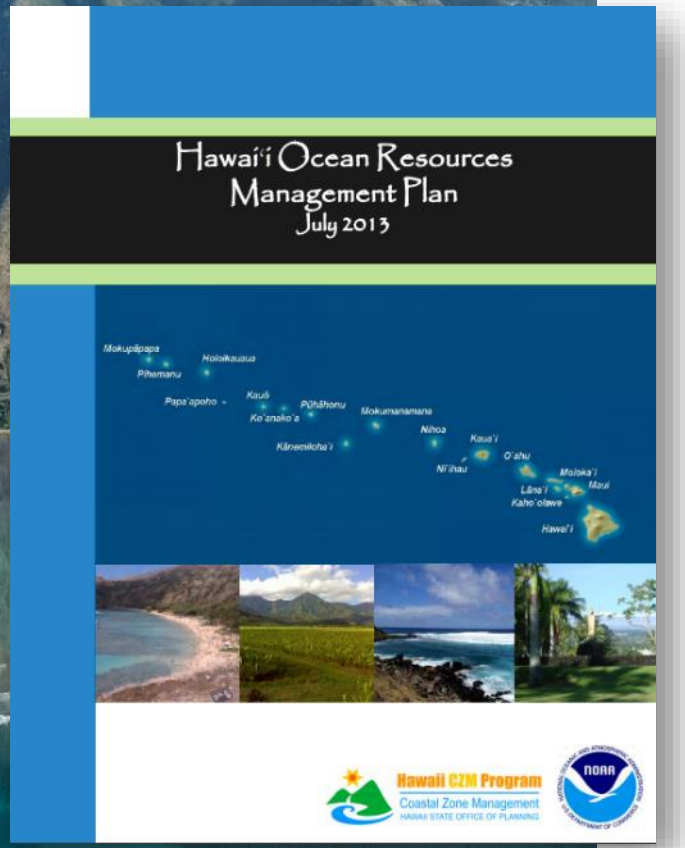


VISIT:

https://climate.hawaii.gov/commission/

http://www.pacioos.hawaii.edu/shoreline/slr-hawaii/

Ocean Resources Management Plan



§205A-3 Lead agency.

The lead agency shall:

(11) Coordinate the implementation of the ocean resources management plan. [L 1977, c 188, pt of §3; am L 1979, c 200, §2; am L 1989, c 356, §5; am L 1993, c 258, §2; am L 1995, c 104, §6; am L 2001, c 169, §4]

- Focus on integrated management and collaboration

Hawaii CZM Program
Coastal Zone Management
HAWAII STATE OFFICE OF PLANNING

Collaborative Efforts

§205A-3 Lead agency.

The lead agency shall:

(7) Prepare and periodically update a plan for use of coastal zone management funds to resolve coastal problems and issues that are not adequately addressed by existing laws and rules;

In order to 'resolve coastal problems and issues', the ORMP:

- Facilitates enhanced understanding of each other's responsibilities and challenges, finding management gaps and **opportunities for action**
- **Tracks partner progress** in implementing individual mandates though data collection
- **Encourages partnership** on Action Team projects and implementing actions identified as management gaps

A Brief History of Surfing, 2014

Hawaii CZM Program
Coastal Zone Management
HAWAII STATE OFFICE OF PLANNING

Mahalo!

http://planning.hawaii.gov/czm

State of Hawaii Office of Planning

P.O. Box 2359, Honolulu, Hawaii 96804

(808) 587-2846

Hawaii CZM Program

Coastal Zone Management

HAWAII STATE OFFICE OF PLANNING

Revamping a resource:
the CHRN website

Jackson Blalock, Washington Sea Grant

Felicia Olmeta-Schult, Department of Ecology

Karen Morrill-Mcclure, Washington Sea Grant

- Project context and motivations
- Website walk-thru
- Next steps: how CHRN **(you!!!)** can help

Bay Center, WA
Washington Department of Ecology Shoreline Viewer

WASHINGTON COASTAL HAZARDS RESILIENCE NETWORK

Strengthening the resilience of Washington's coastal communities to natural hazards impacts through collaboration, education, and resource exchange.

PROJECTED SEA LEVEL RISE FOR WASHINGTON STATE - A 2018 ASSESSMENT

BLOG: MEMBER UPDATES

New material available: Community Update Meeting & Open House
Willapa Shoreline Erosion Protection Demonstration Project

Bolstering resilience to weather hazards for the state's coastal communities.

The Washington Coastal Resilience Project

USGS science for a changing world

CLIMATE IMPACTS GROUP

Sea Grant Washington

DEPARTMENT OF ECOLOGY State of Washington

The Nature Conservancy

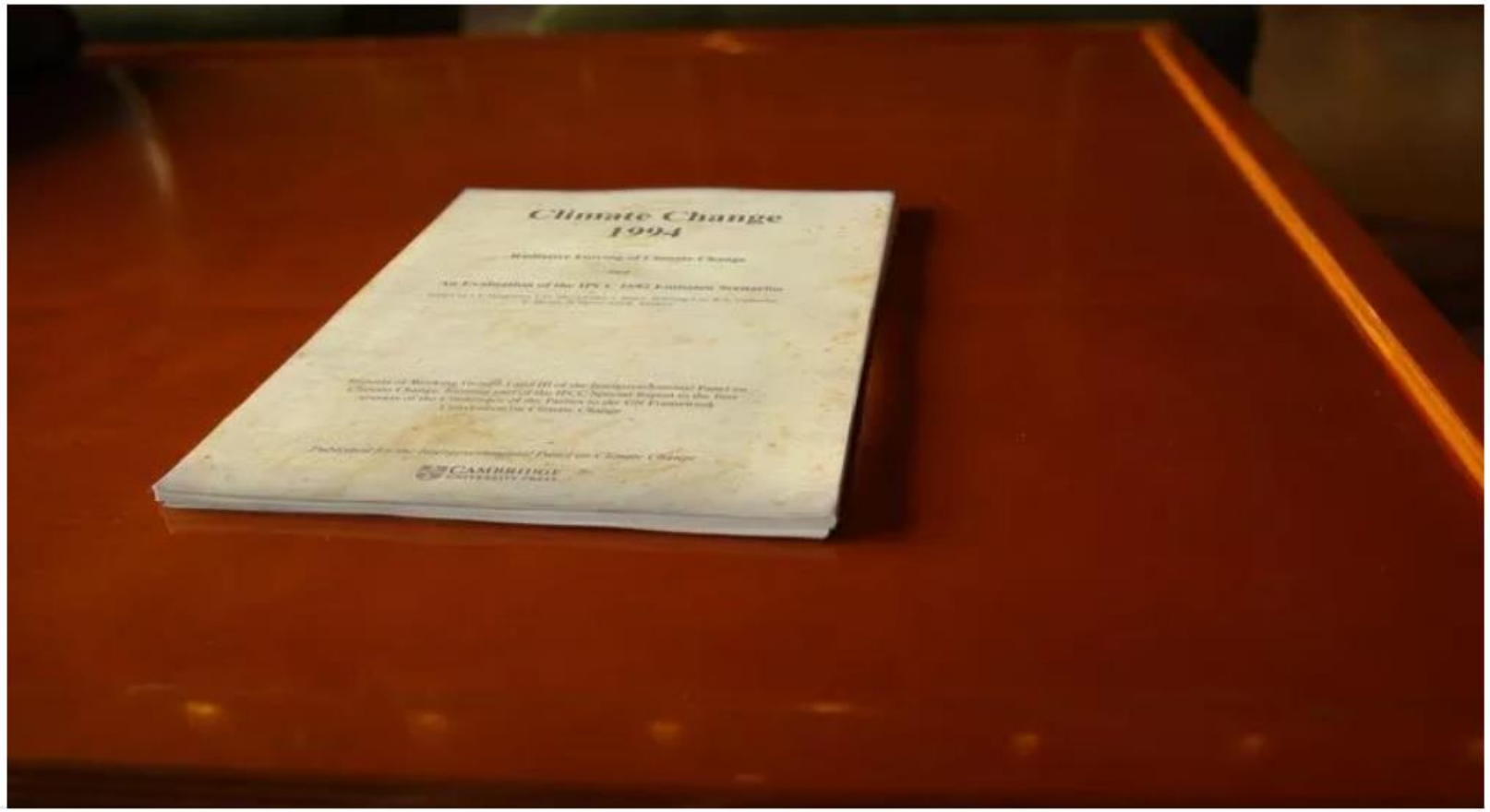
Goal: Increase regional capacity to build resilience to changes in relative sea level.

*Objective: Produce sea level rise projections, guidance, & tools that are **usable** by coastal communities.*

THE WASHINGTON COASTAL RESILIENCE PROJECT

‘The Time To Act Is Now,’ Says Yellowing Climate Change Report Sitting In University Archive

4/01/16 12:15pm • SEE MORE: SCIENCE & TECHNOLOGY



the ONION®

Audiences

Technical experts, agencies (CHRN members)

Local jurisdictions' staff, commissioners

Community members engaged in planning and development

Where should we go to assess SLR-related community needs?

MRC representation:

- *Government:*
  - *Tribal*
  - *Federal*
  - *State*
  - *Counties*
  - *Cities*
- *Parks & preserves*
- *Conservation/Environment*
- *Tribal interest*
- *Local citizens*
- *Education*
- *Science*
- *Recreation*
- *Sport fishing*
- *Commercial fishing*
- *Aquaculture*
- *Ports*
- *Economic groups*

Marine Resource Committees

Sea Level Rise: Strategic Communications Planning:
a tool to help identify and prioritize key messages

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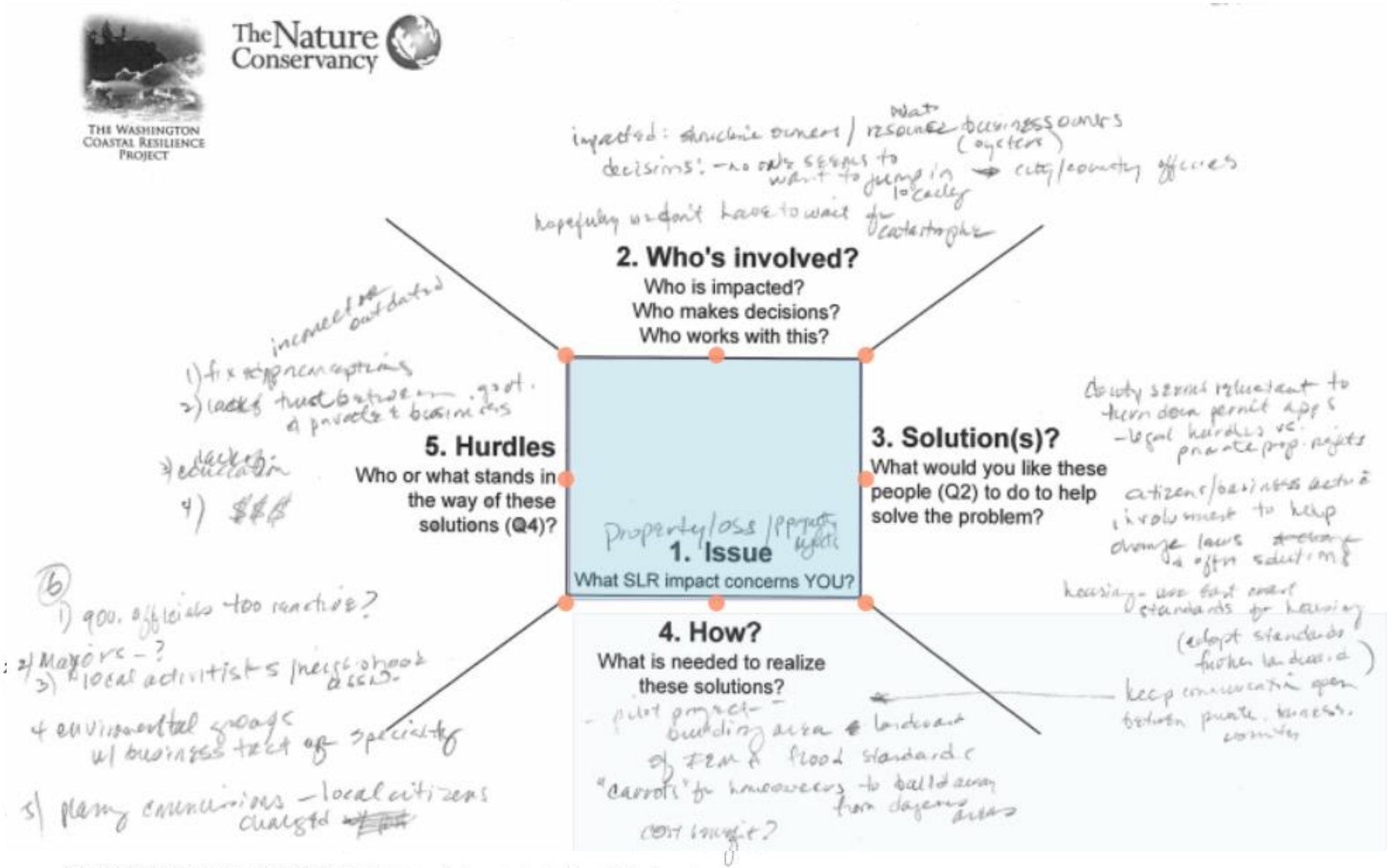
The Nature Conservancy



This worksheet is based on the Smart Chart strategic communications planning tool from Spitfire Strategies and COMPASS's Message Box, used for strategic communicatins by ReefResilience.org

3:1 Pacific County MRC_...

- hurdle: A2 resources - info-bas...
- hurdle: A3 resources - network...
- hurdle: C perspective - mental...
- influencer: C2 local/tribal repre...
- influencer: D1 res. prov. - instit...
- influencer: E2 community orgs
- issue: A1 dev - developed and...
- loc: Pacific
- solution-education-local gov't
- solution-education-property o...
- solution-mental models-long-t...
- solution-mental models-priorit...
- solution-networks-collaboration
- solution-resources-case studie...
- solution-setbacks/zoning

Materials development

Co-production
20+ economic orgs.

Outreach events
King Tides Viewing Parties, SCPG trainings

Takeaways

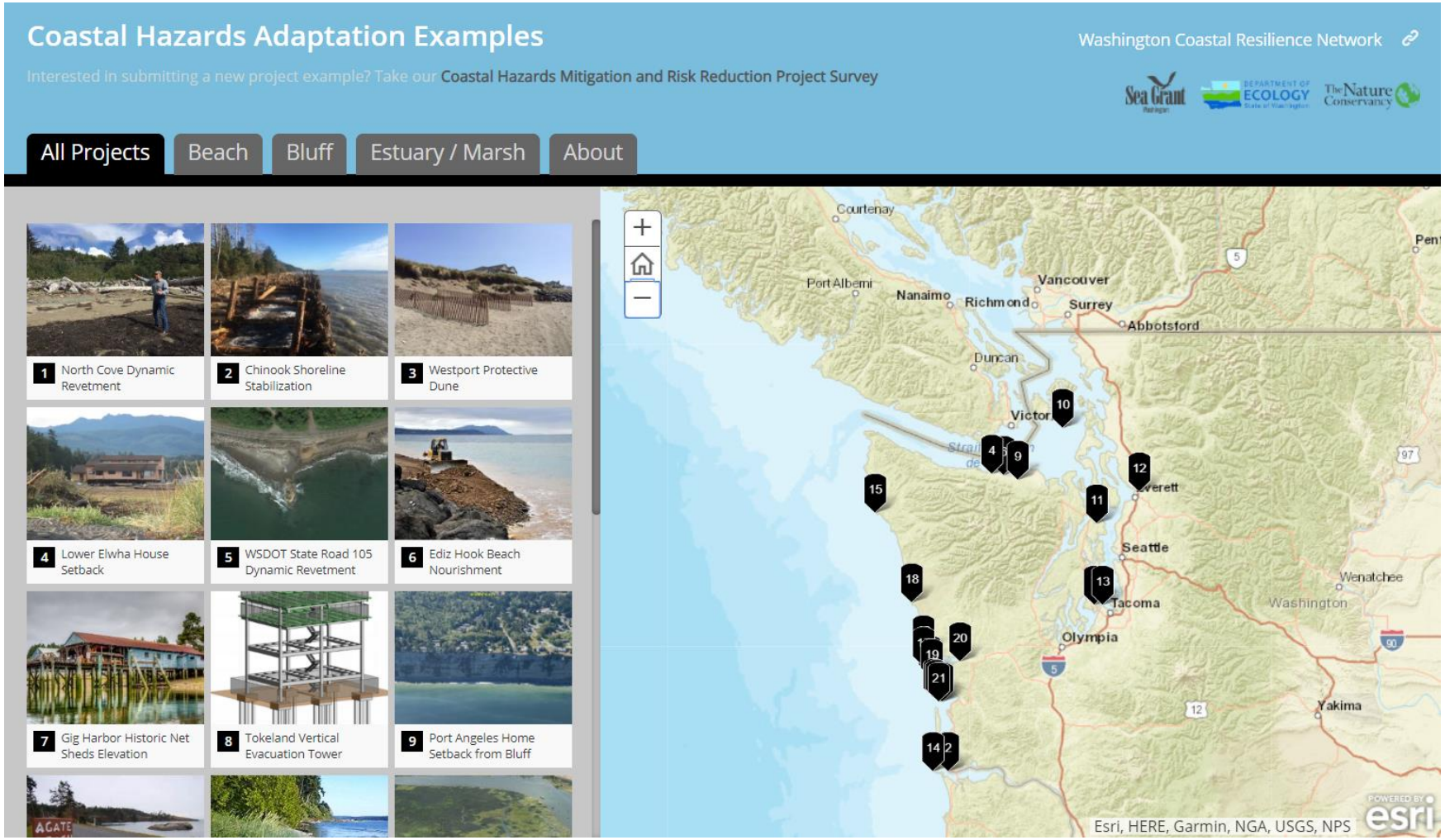
Lack of ability to apply info in context

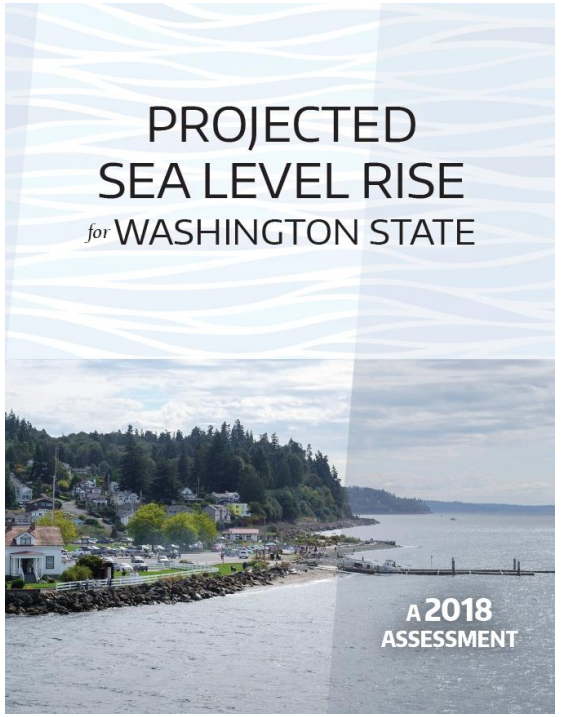
- “gradient of complexity”: multiple audiences
- “5-15-45 minute” approach
- Project-based application

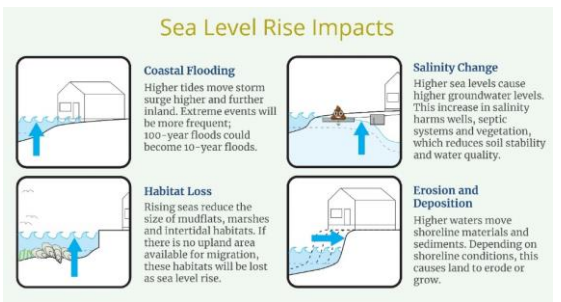
Communicate basics – simplify approaches

- “How much, when, what can I do about it?”
- Relate to existing activity and events
- Focus on visuals: graphics, photos and maps

Where should these (and more) products live?

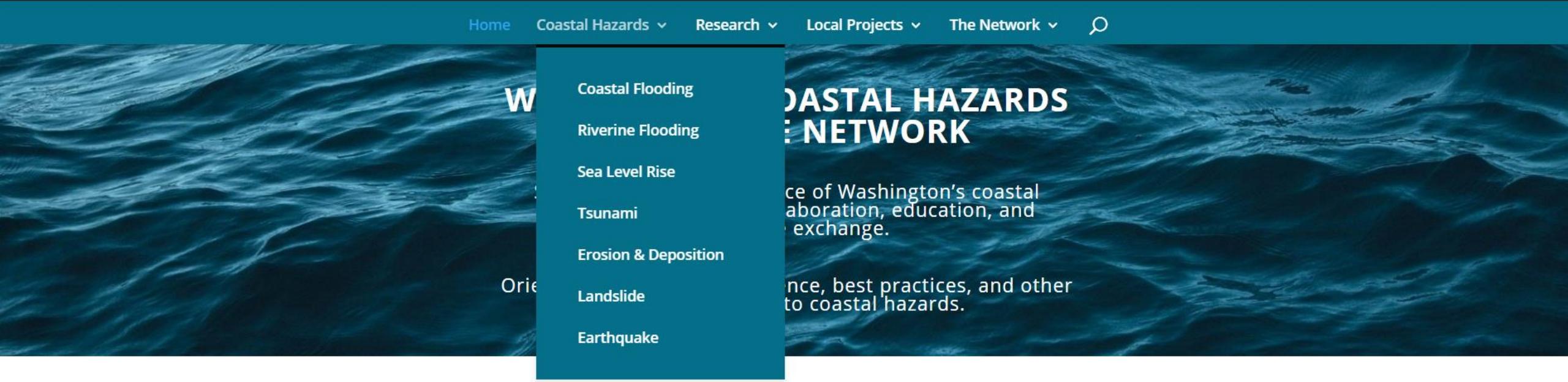






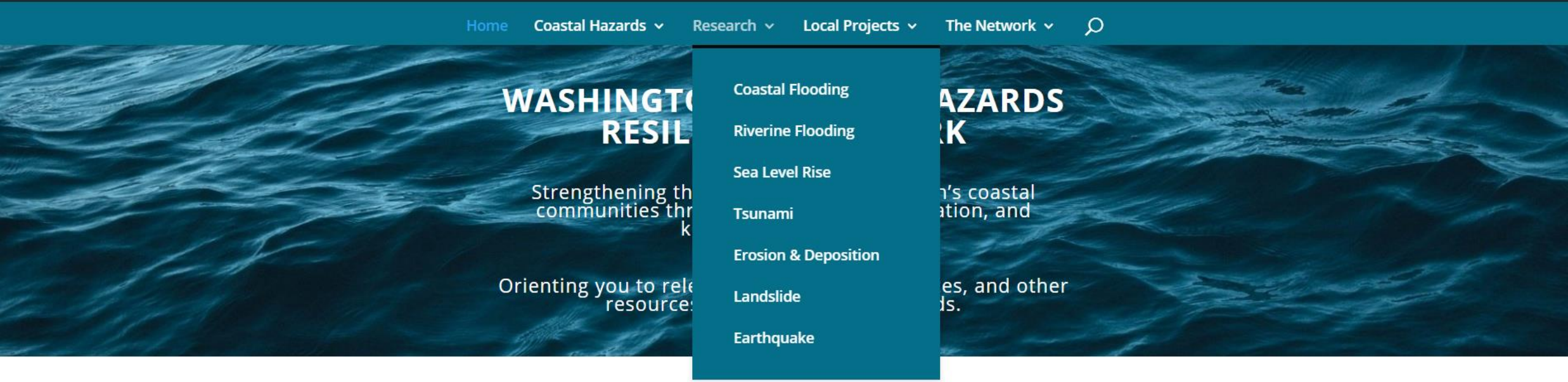
Sea Grant Washington

DEPARTMENT OF ECOLOGY State of Washington



Updates

- Mission: "Orientation"
- Content: "gradient of complexity" to meet multiple audiences, targets usability
- Hazard-specific introduction pages



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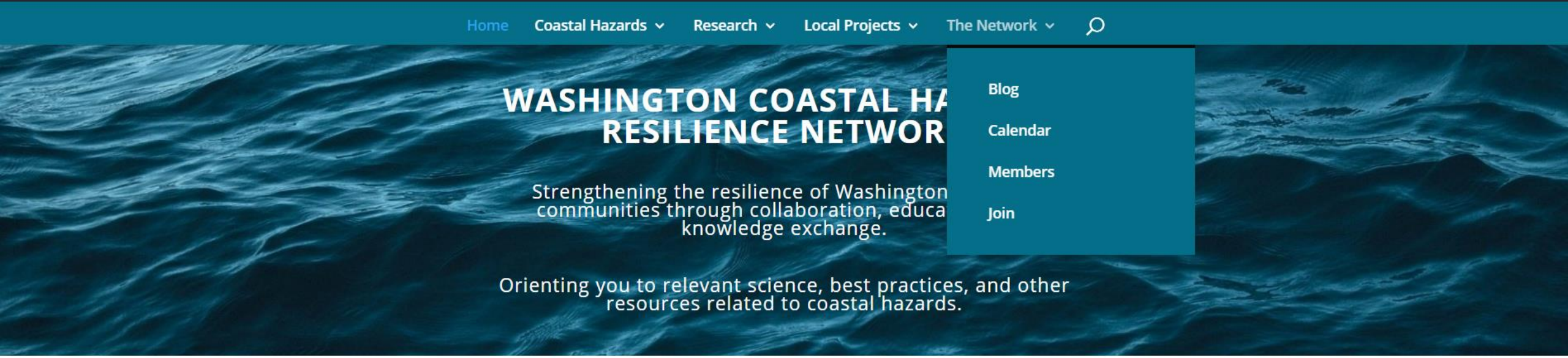

Updates

- Mission: “Orientation”
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- Hazard-specific research pages (data, tools, etc.)
- Examples and resources for project development
- Network **activity**

Link: Draft CHRN site

WASHINGTON COASTAL HAZARDS RESILIENCE NETWORK

Strengthening the resilience of Washington's coastal communities through collaboration, education, and knowledge exchange.

Orienting you to relevant science, best practices, and other resources related to coastal hazards.

Updates on the Willapa Shoreline Erosion Protection Demonstration Project

Events for week of June 3, 2019

« Previous Next »


What’s on the horizon?

Get involved!

- Review website before release
- Share useful coastal hazards tools and research
- Write a blog post: *wacoastalnetwork@gmail.com*
- Share case studies of adaptation efforts
- SHARE and USE the website in your work

Stay in touch!

with everyone in this room…

with WAcoastalnetwork.com…

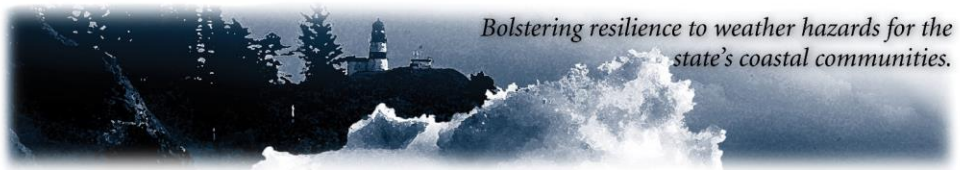
jackbla@uw.edu

Adaptation Case Studies

PRESENTED BY

Katrina Radach[1,2], Jackson Blalock[1,2], Alex Rosen[3]

1. The Nature Conservancy, 2.Washington Sea Grant, 3. Department of Ecology



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What are the Adaptation Case Studies?

Bolstering resilience to weather hazards for the state's coastal communities.

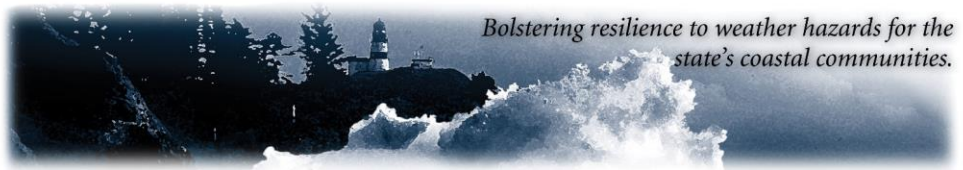
THE WASHINGTON COASTAL RESILIENCE PROJECT

Project Background

- **Department of Ecology:**
  - Communities were asking for examples
  - Difficult to follow up with communities
  - Discovered case studies would be a valuable tool
  - Strong need for capturing relevant risk reduction examples

- **TNC with WCRP**
  - Lack of alternative measures
  - Knowledge gaps
  - Access to information
  - Locally applicable solutions
  - Staffing challenges

- **Merging efforts between Ecology, WCRP, and TNC**



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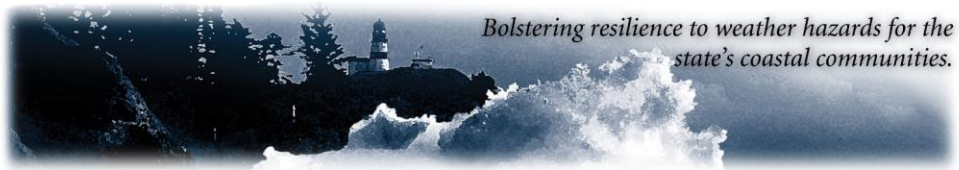
Surveys – Still Active!

- bit.ly/WAadaptation – Case sensitive!
- 26 responses, so far…
- Erosion = primary hazard being mitigated
- Structural mitigation strategies most common
- Damage or threat of damage is greatest motivation for these efforts
- Diverse array of opportunities to enhance outcomes, most prominently:
  - Access to data
  - Engineering guidance
  - Enhanced cross-agency collaboration



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Case Study Interviews

- Regulatory Requirements
- Cost / Funding Dynamics
- Partnerships
- Challenges / Barriers
- Lessons Learned
- Identification of local “champions”
- Top Recommendations

Bolstering resilience to weather hazards for the state’s coastal communities.

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Lessons Learned

- Work with agencies at the beginning. Conversations around collaboration
- Design with Nature
- Hire experienced consultants/engineers
- Budget and plan ahead
- And More!

The Nature Conservancy
Washington

Coastal Hazards Adaptation Examples

Washington Coastal Resilience Network

Interested in submitting a new project example? Take our **Coastal Hazards Mitigation and Risk Reduction Project Survey**

All Projects | Beach | Bluff | Estuary / Marsh | About

1 North Cove Dynamic Revetment

2 Chinook Shoreline Stabilization

3 Westport Protective Dune

4 Lower Elwha House Setback

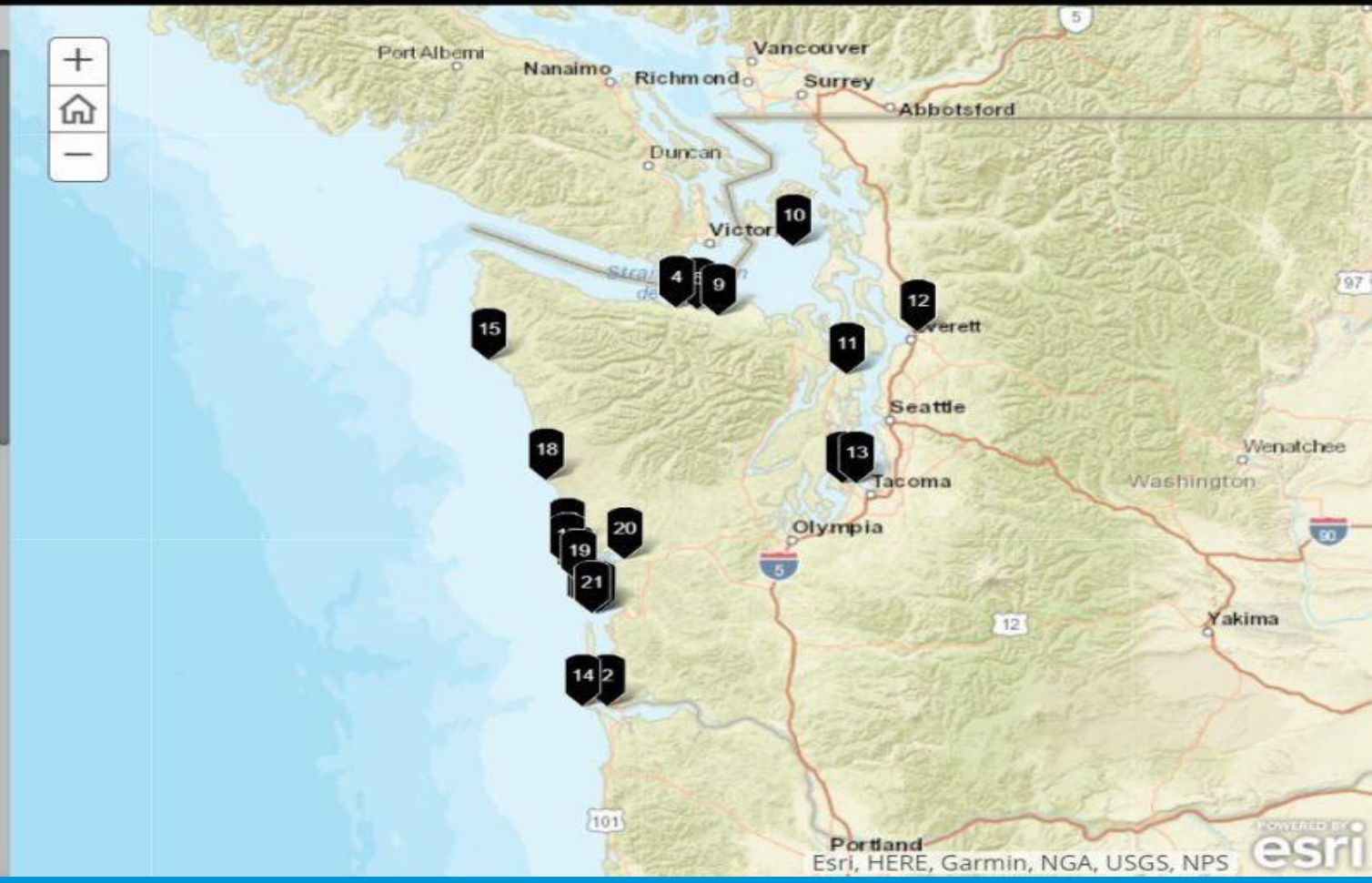
5 WSDOT State Road 105 Dynamic Revetment

6 Ediz Hook Beach Nourishment

7 Gig Harbor Historic Net Sheds Elevation

8 Tokeland Vertical Evacuation Tower

9 Port Angeles Home Setback from Bluff



Bolstering resilience to weather hazards for the state's coastal communities.

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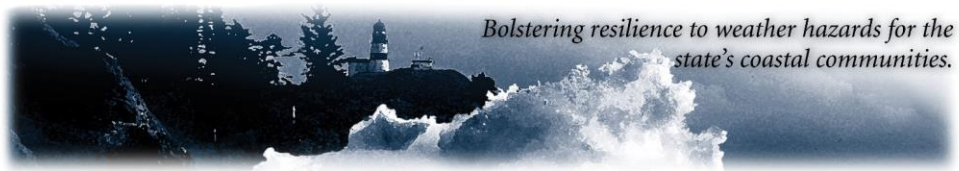
Case Studies Atlas

Who is it for?



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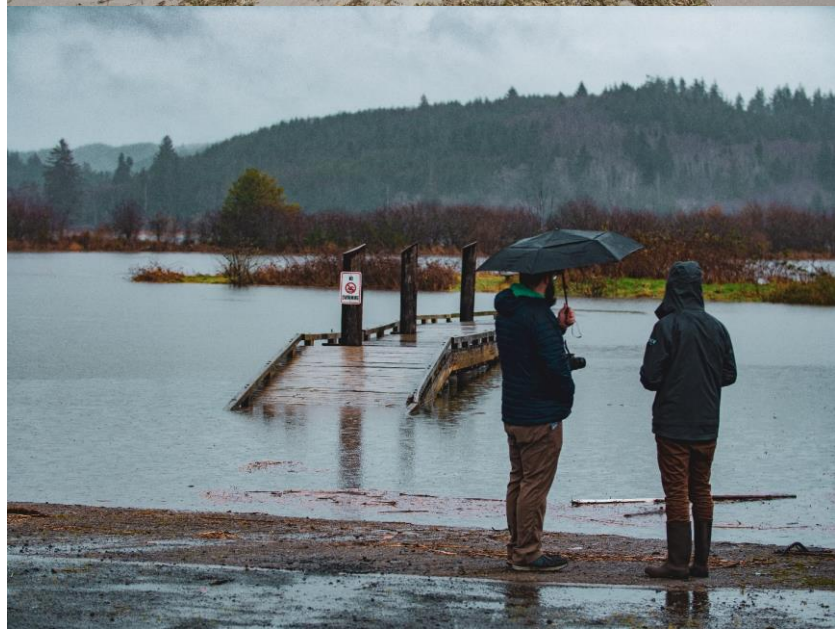
The Who

- Homeowners & Non-Technical Audiences
- Local Governance
- Tribes
- Conservation Districts
- Planners
- Consultants
- Marine Resource Committees
- Anyone who works or is interested in Coastal Hazards



Bolstering resilience to weather hazards for the state's coastal communities.

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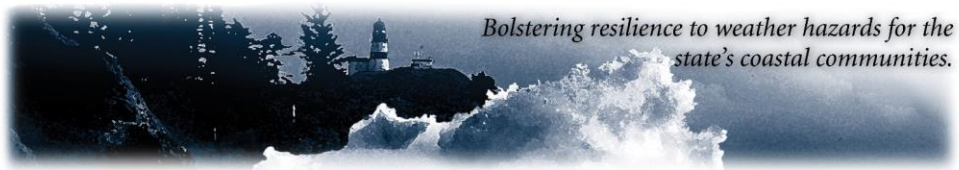
Where can we find it?



THE WASHINGTON COASTAL RESILIENCE PROJECT

WASHINGTON COASTAL HAZARDS RESILIENCE NETWORK

Home | Coastal Hazards | Research | Local Projects | The Network

Strengthening the resilience of Washington's coastal communities through collaboration, education, and resource exchange.

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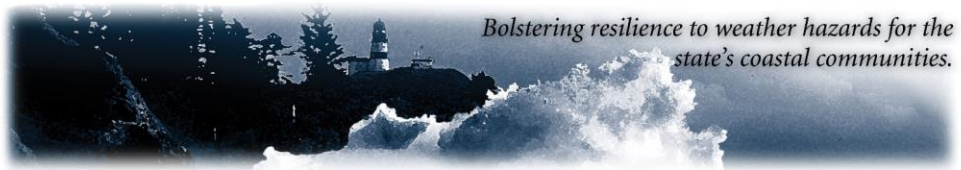
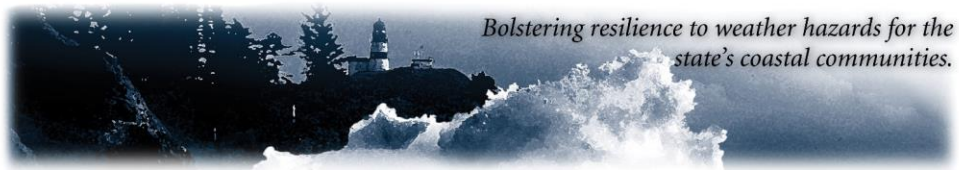


http://www.wacoastalnetwork.com

Questions?



THE WASHINGTON COASTAL RESILIENCE PROJECT

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Jackson Blalock, ASLA
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MacLennan	Andrea	Coastal Geologic Services.	andrea@coastalgeo.com

CHRN 2019 Annual Meeting List of Attendees			
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Miller	Ian	Washington Sea Grant	immiller@uw.edu
Mull	Jeremy	Coastal Engineer at AECOM.	jeremy.mull@aecom.com
Nelson	Kira	City of Olympia	knelson@ci.olympia.wa.us
Norton	Jessica	State Parks	jessica.norton@parks.wa.gov
Nouri	Youness	Moffat & Nichol	ynouri@moffattnichol.com
Olmeta-Schult	Felicia	WA Dept. of Ecology	folm461@ecy.wa.gov
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Penny	Meredith	Island County	m.penny@co.island.wa.us
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Raymond	Crystal	UW	clrfire@uw.edu
Roop	Heidi	University of Washington Climate Impacts Group & School of Public Health	hroop@uw.edu
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Weiner	Heather	WA Dept. of Ecology	hbar461@ecy.wa.gov
Whitely-Binder	Lara	King County	lwbinder@kingcounty.gov
Williams	Terry	Tulalip Tribes	

NAME	MY PROJECT in 10 WORDS or LESS
Félicia OLHETA-SCHULT	Incorporating SLR/climate change considerations into capital grant programs.
Sydney Fishman Kathryn Braddock	Interviewing local govs about bulkhead reg. implementation The state of Marine & Coastal Climate adaptation in N. America
KATRINA RADACH	connecting our communities to updated science ↳creating tools, resources, & collaborative efforts
BECKY LUNDE	Helping improve state & local access to Federal resources, including $ $ $
KIRA NELSON	PRESENTING POT. SLR IMPACTS + ADAPTATION STRATEGIES TO THE OLYMPIA COMMUNITY
BRIAN MCTEAGUE	SLR RISK ASSESSMENT & MITIGATION PLANNING FOR THE SOUTH SALISH SEA. SQUAXIN ISLAND TRIBE

NAME	CONTACT ME ABOUT...	I WANT TO KNOW MORE ABOUT...
Sydney Fishman	Bulkhead regs; soft shore alternatives	SLR + bulkhead impacts
Félicia OLHETA-SCHULT	SLR + Capital grant programs; CHAN website – Membership + blog	SLR in grants + projects
Becky Lunde	Aligning hazmit actions and adaptation strategies across planning efforts ...and new NOAA tools.	Adaptation planning in NA
KATRINA RADACH	creating resources/tools, collaborative approaches & barriers communicating science	community adaptation efforts, adaptation planning & policy
HENRY PETERSON	Agency coordination, education, social marketing, fecal pollution	SLR impacts on waste water & septic systems
Mitch Paine	Flood hazard regulations & the NFIP (flood insurance)	SLR projects & funding